SIEMENS

Photovoltaics

SINVERT

PVS 600Series

Operating Instructions

Edition 08/2014

Answers for the environment.

SIEMENS

SINVERT inverter

Central inverter PVS 600Series

Operating Instructions

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction 1

1.1 Preface

Purpose of the manual

These operating instructions contain all the information required for installing, commissioning, and operating PVS 600Series inverters.

This manual is aimed at qualified personnel in the following target groups:

- Planners
- Installation personnel
- Commissioning engineers
- Service and maintenance personnel
- Operators

Validity of the documentation

The operating instructions apply to the inverters

- SINVERT PVS500, SINVERT PVS1000, SINVERT PVS1500 and SINVERT PVS2000 with frequencies of 50 Hz and 60 Hz.
- SINVERT PVS585, SINVERT PVS1170, SINVERT PVS1755 and SINVERT PVS2340 with frequencies of 50 Hz and 60 Hz.
- SINVERT PVS600, SINVERT PVS1200, SINVERT PVS1800 and SINVERT PVS2400 with frequencies of 50 Hz and 60 Hz.
- SINVERT PVS630, SINVERT PVS1260, SINVERT PVS1890 and SINVERT PVS2520 with frequencies of 50 Hz and 60 Hz.

Conventions

Within this manual, the shortened name SINVERT PVS is used in addition to the full product name when referring to inverters.

Photovoltaic system is shortened to PV system.

Trademarks

SINVERT® is a registered trademark of Siemens AG.

1.2 Recycling and disposal

Devices described in this programming manual can be recycled owing to the low content of noxious substances in their version. Please contact a certified waste disposal company for eco-friendly recycling and to dispose of your old devices.

Safety instructions 2

2.1 General safety instructions

Note

Please observe the legal information and the safety instructions on the back of the cover sheet of this documentation.

Qualified personnel

Installation, commissioning, operation and maintenance of this device must be carried out by qualified personnel only.

- The installation engineer must be qualified according to national guidelines.
- Approval by the relevant electrical utility may also be necessary.

Intended use

To ensure the greatest possible degree of system safety, it is absolutely essential that the product is used for its intended purpose.

The SINVERT inverter and its variants are designed solely for the purpose of converting the energy generated by PV modules from a DC current into an AC current and of feeding this AC current into a medium-voltage grid. Compliance with all specifications regarding permissible conditions of use as outlined in these operating instructions is essential. To satisfy this requirement, it is essential that these operating instructions are read in full by the qualified personnel responsible for the system and that all instructions are followed.

In addition, the conditions specified by the PV module manufacturer and grid operator must be fulfilled. The products may be modified only with the agreement of the manufacturer.

It is not permissible to commission the system unless all requirements are satisfied in full. Any usage other than that described in this chapter is deemed to be improper usage. Siemens disclaims liability for any damage attributable to improper usage.

Use of approved equipment and components

Always use the equipment and components described and approved by the manufacturer for the intended purpose. The manufacturer disclaims liability for any damage arising from the use of equipment or components which are not approved for the intended purpose.

Modifications to the product

Modifications to the SINVERT inverter may be made only if these have been explicitly approved by the system manufacturer. The manufacturer shall not be liable for any damage arising from unapproved modifications to the SINVERT inverter.

Repairs

Only authorized personnel are permitted to repair the device.

Electrical voltages

The PVS cabinets must be opened and worked on by qualified personnel only.

⚠ WARNING

Hazardous electrical voltages at the opened cabinet

Even if the device is switched off, life-threatening voltage may be present inside the cabinet.

Consequently, only qualified expert personnel must work at the open cabinet in compliance with the safety rules.

2.2 Health and safety at work

It is essential that you adhere to the health and safety regulations, e.g. VDE 105-1/EN 50110-1 (Operation of Electrical Installations), which apply at the relevant installation site.

Protective gear and equipment

Qualified personnel must always carry the protective gear, tools and accessories listed below and use them in the prescribed manner:

- Insulating footwear, gloves and shoe covers
- Goggles and protective face masks
- Protective headwear
- Appropriate protective clothing
- Ear protection
- Insulating cover materials, flexible or rigid
- Insulated tools and tools made of insulation material
- Locks, labels and notices, signs
- Voltage testers and test systems
- Grounding / short-circuiting devices and fixtures
- Materials for barrier erection, flagging and signing.

Following EN 50110-1 all tools, items of equipment, protective gear and other accessories must be suitable for the intended purpose and in good condition. They must be used for the prescribed purpose and stored properly.

Precautionary measures for increasing safety

Follow all instructions and safety notices. Never work alone on the unit. In the event of an accident, a second person must be capable of administering first aid immediately.

⚠ WARNING

Risk to life; serious physical injury, substantial damage to equipment! Hazardous voltages and currents!

All work must be carried out by qualified personnel. Follow all instructions relating to health and safety at work. Failure to adhere to safety procedures could result in death, serious physical injury and/or substantial property damage.

2.3 Hazards during handling and installation

Improper handling and installation of certain parts and components can result in injury under unfavorable conditions.

⚠ CAUTION

Danger of injury due to improper handling! Injury by crushing, jackknifing, cutting, bumping, or lifting!

- The general construction and safety regulations must be observed in handling and installation.
- Each cabinet section weighs more than 1,000 kg.
- Suitable installation and transport equipment must be used. Read the specifications and safety information of the chapter Application planning (Page 81).
- Only use suitable tools.
- Lifting equipment and tools must be used correctly.
- Suitable protective equipment (e.g. safety goggles, safety shoes, protective gloves) must be used.
- Never stand underneath suspended loads.

2.4 Hazards in photovoltaic plants

Below are listed some typical special features and hazard sources in photovoltaic plants:

- Since the short-circuit current only slightly exceeds the maximum operating current, there is no clear guarantee that the available fuse will trip in the event of a short-circuit.
- Depending on the operating status, the plant can still be under power from the PV generator via the SINVERT PVS inverter even when it is switched off. This must be remembered when isolating the plant or sections of the plant.
- The PV generator is usually configured as an IT system without grounded transformer. A ground fault generates a fault message. In an IT system, there is no immediate danger of electric shock if no further fault occurs. Despite this, the ground fault must be corrected as quickly as possible by qualified personnel.

2.5 Incorrect grid monitoring parameters

NOTICE
Withdrawal of operating permit If you operate the SINVERT PVS inverter with the wrong grid monitoring parameters, the electrical utility can withdraw your operating permit. The device must therefore only be commissioned by authorized service personnel. The system settings must be adapted to local requirements regarding grid monitoring parameters.

We assume no responsibility for incorrect grid monitoring parameters.

2.6 Possible safety gaps in the case of standard IT interfaces

In SINVERT inverters, extensive parameterization and diagnostics functions are provided via open protocols and interfaces (e.g. Web server, network management). The possibility of unauthorized misuse of these open protocols and interfaces by third parties, for example to manipulate data, cannot be entirely excluded.

When using the functions listed above and these open interfaces and protocols (for example, SNMP, OPC, HTTP), you should take suitable security measures to prevent unauthorized access to the components and the network, particularly from within the WAN/Internet.

NOTICE
We expressly point out that the inverter network must be isolated from the rest of the company network by suitable gateways (for example, field-proven firewall systems). We do not accept any liability whatsoever, whatever the legal justification, for damage resulting from non-adherence to this notice.

If you have questions on the use of firewall systems and IT security, please contact your local Siemens office or representative.

2.7 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. For more information about industrial security, visit http://www.siemens.com/industrialsecurity.

To stay informed about product updates as they occur, sign up for a product-specific newsletter. For more information, visit http://support.automation.siemens.com.

Description

3

The inverter of the SINVERT PVS device line is used in medium and large PV plants and converts the DC current of the PV generators into AC current. This AC current is then fed into the connected power grid. The SINVERT PVS inverter design is optimized for the lowest possible losses and thus the greatest possible efficiency.

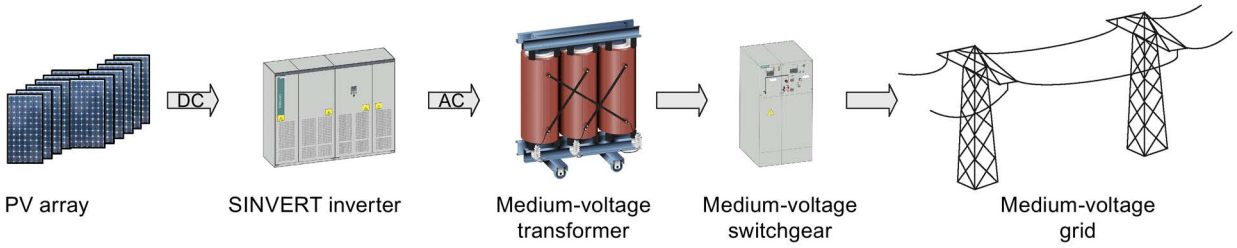


Figure 3-1 Installation overview

The integrated DC and AC distribution makes the system compact and cheap to integrate. The system is provided with standardized interfaces so that it can be integrated into a control system or an existing customer installation.

3.1 Features

SINVERT PVS is a three-phase inverter with the following features:

- Standardized series product with CE mark
- Compliance with international standards: DIN VDE, IEC, EN
- QS system is certified in accordance with DIN EN ISO 9001
- Optimized for high efficiency
- Self-commutated, pulse-width-modulated (PWM) IGBT inverter
- Compact design, very easy to install
- Integrated DC connection including insulation monitor, contactors and semiconductor fuses
- Integrated AC connection with line monitor, line contactor and circuit breaker
- Terminal compartment with separate panels for DC and AC terminal connections
- Overvoltage protection on DC and AC sides
- Operation on AC systems with 50 or 60 Hz
- Enclosed base plate with bushing for connecting cables
- Bus communication via Industrial Ethernet for integration into operations management systems
- Operator control and monitoring elements integrated into cabinet door
- Delivery on special pallets
- Air inlet through ventilation grille at front, air exit at top
- Heat dissipated by low-noise fan
- All cabinet components can be recycled

PVS versions PVS500, PVS585, PVS600 and PVS630

The most important differences between the PVS versions can be seen from the technical data below:

	PVS500	PVS585	PVS600	PVS630
AC output voltage	288 V	340 V	370 V	370 V
Active power generated	500 kW	585 kW	600 kW	630 kW
MPP window	450 … 750 V	530 … 750 V	570 … 750 V	570 … 750 V

3.2 Design

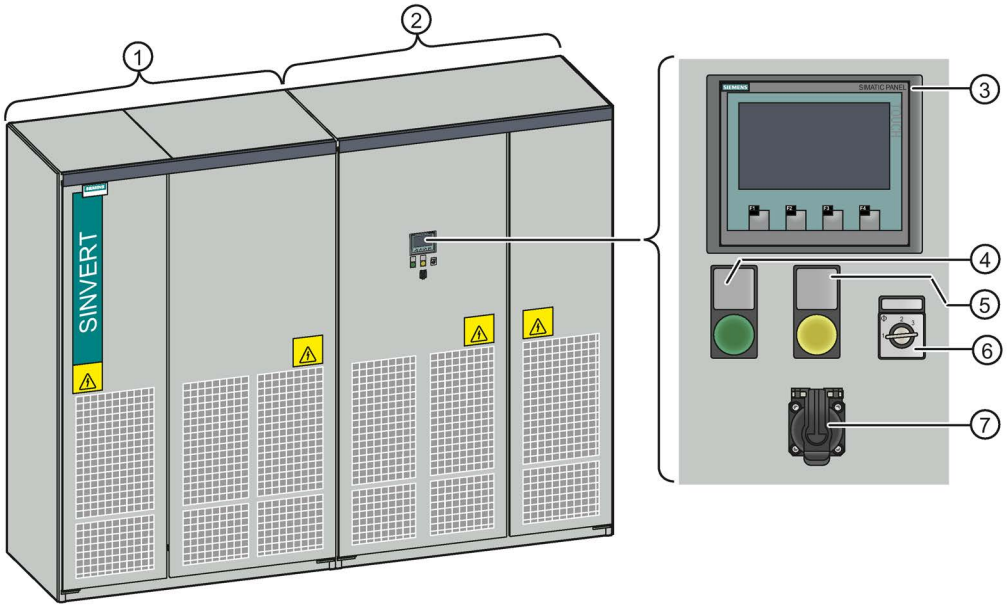
Inverter subunit and inverter unit

An inverter subunit always consists of a DC cabinet and an AC cabinet.

A complete inverter unit can comprise up to 4 inverter subunits (DC/AC cabinets) that are also referred to as master-slave combinations (see Chapter Master-slave combinations (Page 22)).

Design of an inverter subunit

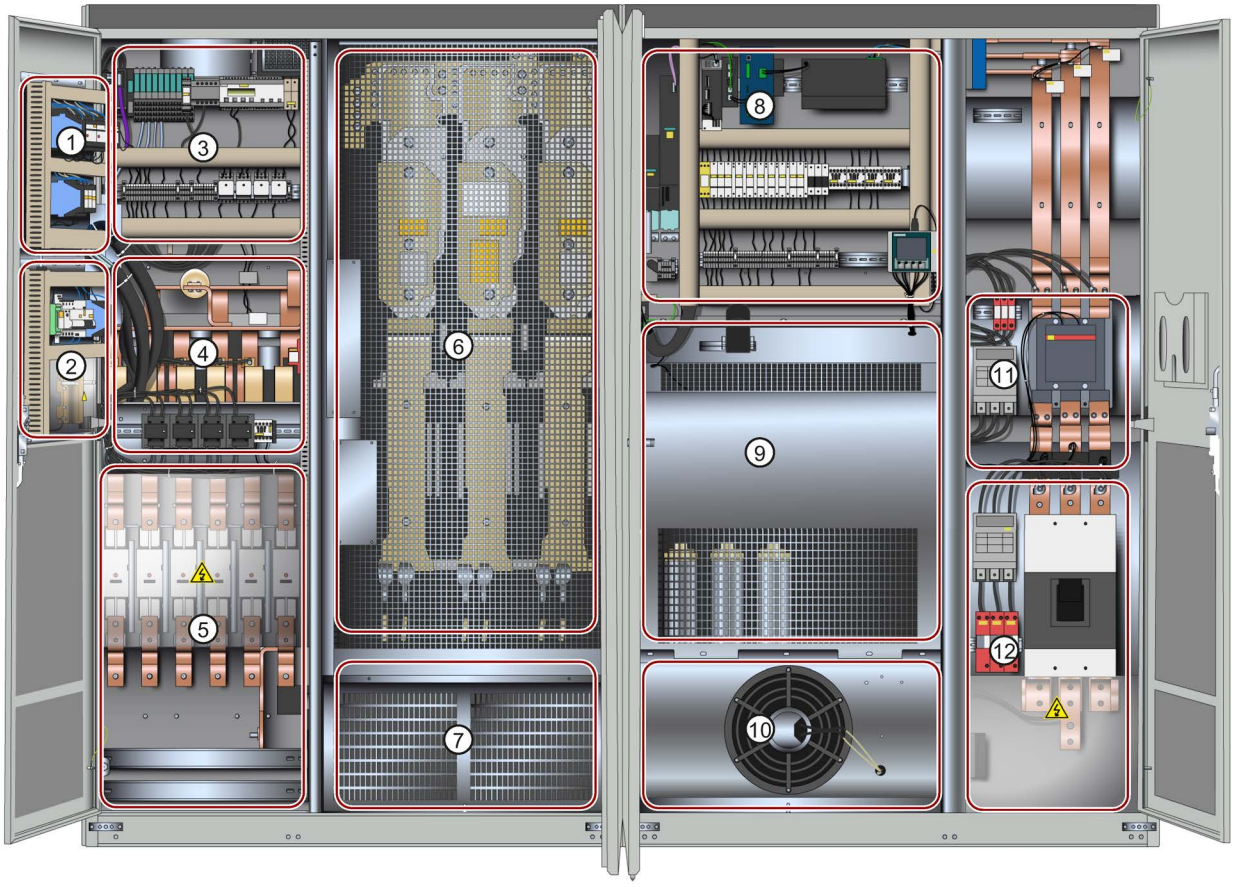
The figure below shows the design principle of the inverter subunit with closed doors:



① DC cabinet
② AC cabinet
③ Touch panel (only available on master unit)
④ Green indicator light "Run"
⑤ Yellow indicator light "Fault"
⑥ Key-operated switch
⑦ Service interface: Industrial Ethernet (for the master unit only)

Figure 3-2 Design of the inverter subunit (master unit)

The figure below shows the higher-level function units of the inverter subunit with open doors.



① Modules for 1000V option
② Modules for PV field grounding option
③ Modules for options
④ DC contactors
⑤ DC terminal compartment of the PV field and LV HRC fuses
⑥ Inverter module (power unit)
⑦ Connection to AC cabinet
⑧ Communication area
⑨ AC filter
⑩ Cooling ventilators, reactors, connection to DC cabinet
⑪ AC contactor
⑫ AC terminal compartment, circuit breaker for isolating the AC system and overvoltage protection

Figure 3-3 Function units of the inverter subunit

3.3 Operating principle

The SINVERT PVS inverter works on the following functional principles:

- The inverters are based on SINAMICS (power unit with IGBT three-phase bridge) and SIMOTION (controller).
- 3 inputs for connecting the PV array are provided at the PV array end.

Note

The PV array must be connected for this purpose in 3 sub-arrays with the same total current and voltage values.

- The 3 inputs on the DC side are equipped with LV HRC fuses and DC contactors. This combination can be used to disconnect the inverter from the PV side.
- AC filters are used to smooth the AC output voltage.
- The AC output must be connected directly to the medium-voltage transformer for galvanic isolation. This is required at the AC output of every inverter subunit.
- A contactor and circuit breaker are used to disconnect the unit from the AC grid.
- Overvoltage protection devices are installed on the AC and DC sides.
- To increase efficiency and reduce no-load losses, up to four inverters can be interconnected in master/slave operation.

Block diagram of the SINVERT PVS 600 Series

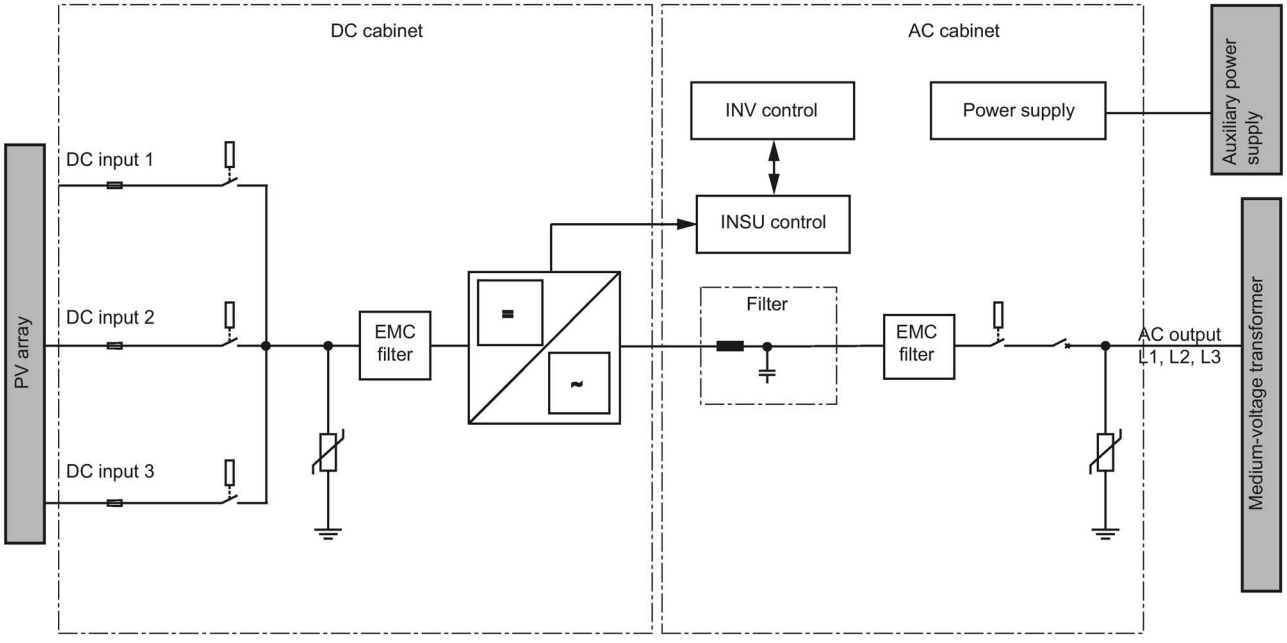


Figure 3-4 Block diagram of the SINVERT PVS 600Series inverter (master version)

3.4 Master-slave combinations

A SINVERT PVS inverter subunit is available in two versions:

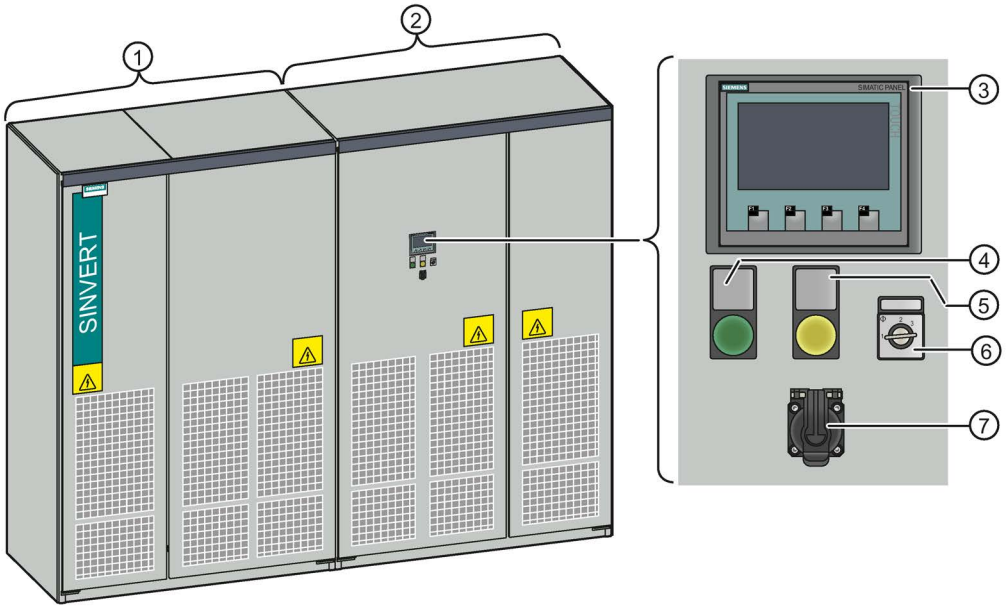
- Master
- Slave

The combination of a master unit and one or more slave unit(s) results in a master/slave combination.

Master

The master comprises a DC cabinet and an AC cabinet with touch panel.
A master with a touch panel is required in every configuration. The master or the entire installation can be operated and monitored via the touch panel.

The SINVERT PVS500, PVS585, PVS600 and PVS630 consist exclusively of one master.



① DC cabinet
② AC cabinet
③ Touch panel
④ Green indicator light "Run"
⑤ Yellow indicator light "Fault"
⑥ Key-operated switch
⑦ Service interface: Industrial Ethernet

Figure 3-5 Master unit

Block diagram of the master unit

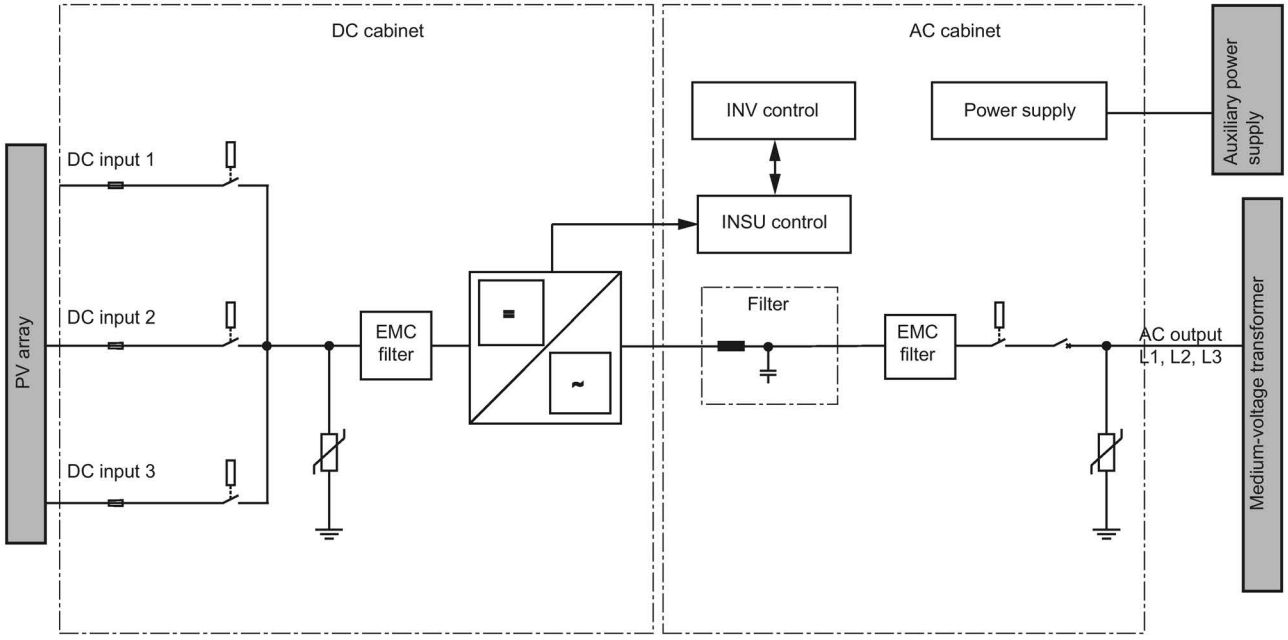
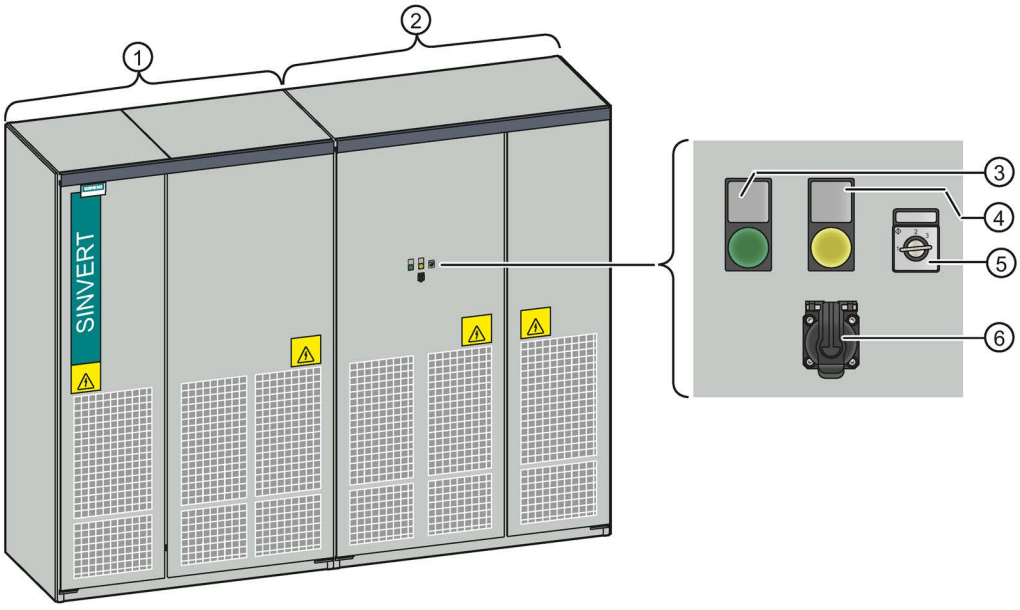


Figure 3-6 Block diagram master

Slave

The slave comprises a DC cabinet and an AC cabinet without touch panel.

Since the slave does not have its own touch panel, it can only be operated and monitored using an associated master or its touch panel.



① DC cabinet
② AC cabinet
③ Green indicator light "Run"
④ Yellow indicator light "Fault"
⑤ Key-operated switch
⑥ Service interface (not functional)

Figure 3-7 Slave unit

Block diagram of the slave unit

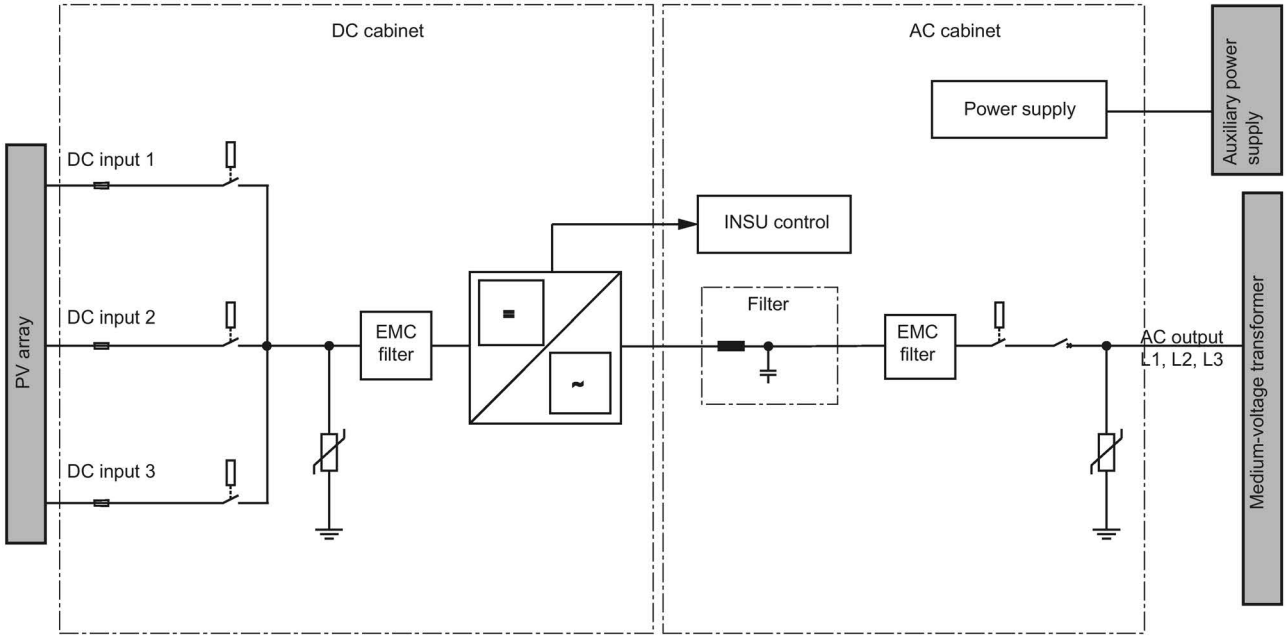


Figure 3-8 Block diagram slave

Master/slave combinations

The inverters of the SINVERT PVS500, PVS585, PVS600 or PVS630 series can be used as single devices or in combination with other inverter subunits in a master/slave combination. Such a combination always has a master and can additionally contain up to three slaves.

The following master/slave combinations are available.

SINVERT PVS500 series	SINVERT PVS585 series	SINVERT PVS600 series	SINVERT PVS630 series	Design
SINVERT PVS500	SINVERT PVS585	SINVERT PVS600	SINVERT PVS630	1 x master (with touch panel on the AC cabinet)
SINVERT PVS1000	SINVERT PVS1170	SINVERT PVS1200	SINVERT PVS1260	1 x master (with touch panel on the AC cabinet) 1 x slave
SINVERT PVS1500	SINVERT PVS1755	SINVERT PVS1800	SINVERT PVS1890	1 x master (with touch panel on the AC cabinet) 2 x slave
SINVERT PVS2000	SINVERT PVS2340	SINVERT PVS2400	SINVERT PVS2520	1 x master (with touch panel on the AC cabinet) 3 x slave

Block diagram of the master/slave combination SINVERT PVS2000 / PVS2340 / PVS2400 / PVS2520

The block diagram of the maximum configuration provides an example of the additional interconnection of the inverter subunits by the DC link.

Note

Each subunit of an inverter must be connected to the medium-voltage transformer with galvanic isolation.

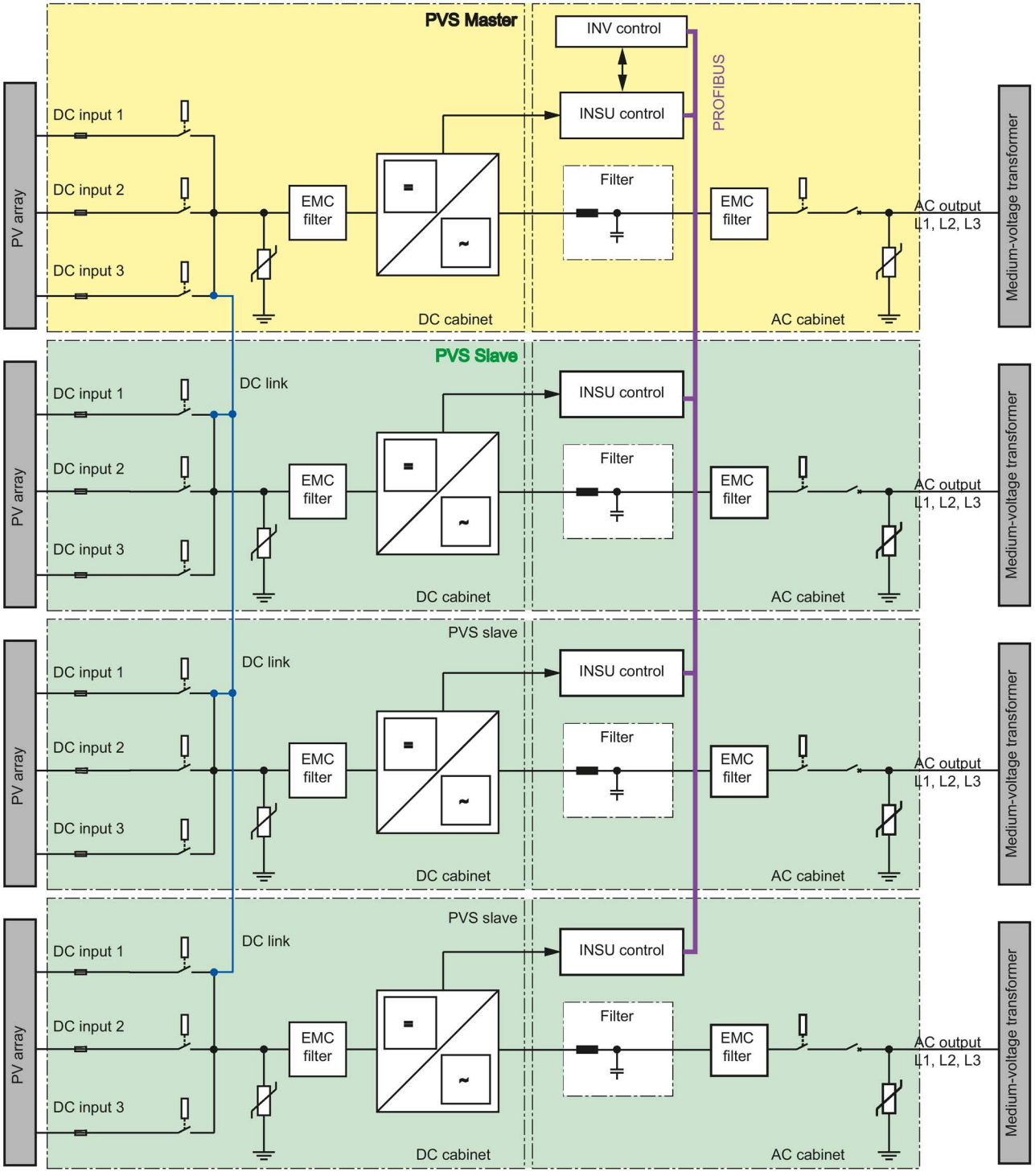


Figure 3-9 Block diagram of the master/slave combination SINVERT PVS2000 / PVS2340 / PVS2400 / PVS2520

3.5 Inverter options

The following functional expansions and options are available for the PVS 600Series:

Option	Option identifier on the nameplate
PV array grounding - positive-pole grounding	PV field grounding positive pole
PV array grounding - negative-pole grounding	PV field grounding negative pole
Increase in max. DC voltage to 1 000 V	Max. UDC Betrieb 1000V
Symmetry monitoring	Symmetry monitoring
Cabinet heating	Cabinet heating

Option identifier on the nameplate

You can see from the nameplate which options your device is equipped with.

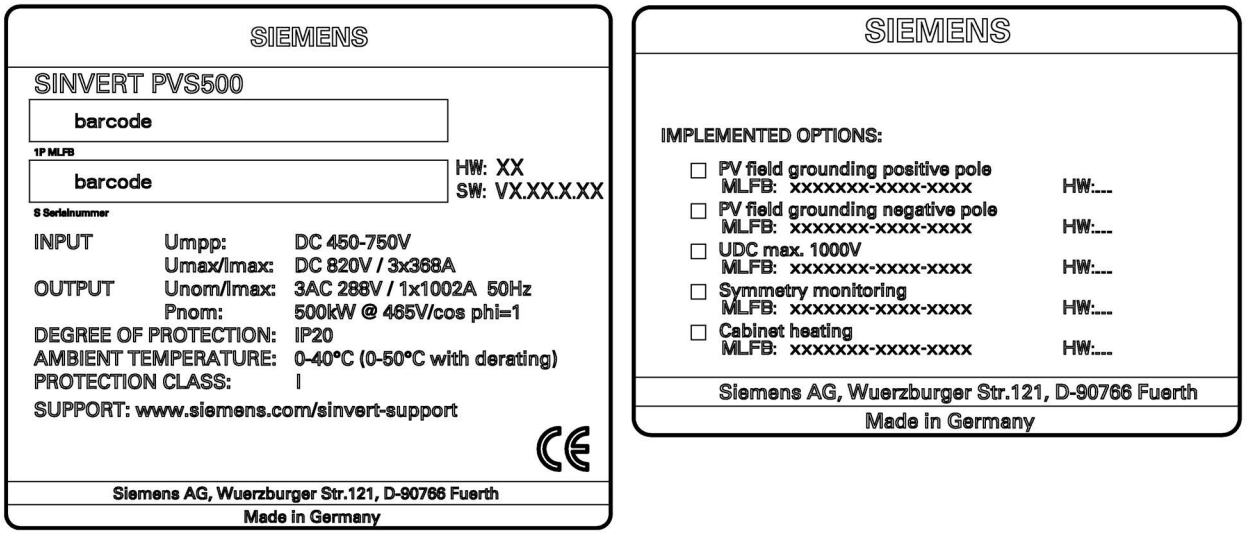


Figure 3-10 Example of a rating plate

3.5.1 PV array grounding

With the optional feature "Positive / Negative PV array Grounding", the SINVERT inverters offer an ideal choice for manufacturers who require a module ground.

Remember: For the latest information about the necessity for and type of grounding, please contact your module manufacturer!

Some module manufacturers recommend positive or negative grounding of the PV generator when certain types of module are used!

PV systems no longer constitute a DC IT system when their modules are grounded. For safety reasons, the PV system must be fenced in and designated as an electrical operating area.

Access must be prohibited to all persons except qualified electricians.

Positive-pole grounding

Grounding an active conductor (positive pole) means that the inverter's insulation measuring function no longer works in the normal way. A hazardous current can start to flow as soon as the first insulation damage occurs. For this reason, the condition of the system is monitored through measurement of the current between the positive pole and ground. If the current level measured is deemed to pose a risk (current value is parameterizable), the connection is automatically broken by means of a motor-operated DC disconnector. This DC disconnector is driven by the inverter's control system. In this context, it is important to note that the connection between the module array and inverter ground must be of high quality. If the connection resistance is high as a result of very dry conditions or unfavorable ground conditions, a sufficiently high current will not flow. It is also important to note that a fault at the same potential when grounded will not drive a current.

The DC disconnector has three settings:

- Remote triggering
- Local operation
- "Off signal" position, lockable

Negative-pole grounding

Grounding an active conductor (negative pole) means that the inverter's insulation measuring function no longer works in the normal way. A hazardous current can start to flow as soon as the first insulation damage occurs. For this reason, the condition of the system is monitored through measurement of the current between the negative pole and ground. If the current level measured is deemed to pose a risk (current value is parameterizable), the connection is automatically broken by means of a motor-operated DC disconnector. The disconnector is driven by the inverter's control system. In this context, it is important to note that the connection between the module array and inverter ground must be of high quality. If the connection resistance is high as a result of very dry conditions or unfavorable ground conditions, a sufficiently high current will not flow. It is also important to note that a fault at the same potential when grounded will not drive a current.

The DC disconnector has three settings:

- Remote triggering
- Local operation
- "Off signal" position, lockable

3.5.2 Increase in max. DC voltage to 1000 V

Areas of application and use

The "1000 V option" increases the maximum DC no-load voltage for inverters to DC 1000 V.

This ensures that the photovoltaic system can also operate with a (no-load) voltage of up to DC 1000 V, for example when operating on cold days. The profitability of the equipment is maximized as more modules can be connected in series, without affecting the ability of the PVS inverter to switch on.

When will the equipment operate at no load?

No-load operation will happen at the following times:

- Before switching on the PV inverter
- After switching off the PV inverter

Standard response of the PVS inverter without the "1000 V option"

The PV inverters of the PVS series feature a switch-on voltage of max. 820 V DC as standard. If the DC voltage is above 820 V, the SINVERT PVS PV inverter will not switch on.

The 1000 V option allows the switching on and off of the SINVERT PVS PV inverter for PV field no-load voltages of up to 1000 V DC.

Switching on the PV inverter with "1000 V option"

Switching on the PVS allows a variable voltage divider, consisting of series and parallel resistors, to activate the inverter DC link (without closing the DC input contactors). Thus only the required fraction of the PV field no-load voltage is present at the DC link, and not the entire PV field no-load voltage. The upstream measurement of the PV field voltage (U_{pv}) is carried out in each individual inverter subunit. Only when the PVS SINAMICS power unit is operating and the AC main contactor is closed do the DC power contactors close in succession.

Switching off the PV inverter with "1000 V option"

When switching off the last (of max. four) PV inverter subunits in normal operation, the DC power contactors are first opened in succession, before the SINAMICS power unit of the inverter subunit is switched off and the AC contactor opened.

During normal operation this ensures that the PV field no-load voltage is not present at the DC link.

Unintentional disconnection of the PV inverter with "1000 V option"

During operation of the PV inverter, situations may arise which lead to the PV inverter and the power unit to be switched off unintentionally. In such cases it is not always possible to successively or immediately switch off the DC power contactors prior to switching off the power unit, or they are switched off too slowly, to prevent the DC link voltage rising to impermissible values. In such cases, to protect the DC link against voltages which are too high, the following components are used:

- 1000 V special chopper
- Chopper resistor
- Crowbar

3.5.3 Cabinet heating

Heating elements are integrated into the inverter to prevent condensation and if atmospheric humidity is too high. These heating elements are controlled by a hygrostat.

3.5.4 Symmetry monitoring

The symmetry monitoring option measures the scaled currents within the inverter at the DC inputs and compares the values with each other.

If this comparison indicates deviations over time, a message is generated. The message can be used for early detection of faults in parts of the photovoltaic field (e.g. cell failure).

3.6 System components

The system components and accessories are used for optimal, flexible, and customized implementation of photovoltaic plants covering all aspects of the SINVERT PVS inverters, as well as expanding the functionality of the overall system.

System components

- SINVERT PVS CombinerBox

  With the SINVERT PVS CombinerBox, the individual strings of the photovoltaic generator are collected in the field, connected in parallel and the energy conveyed across large cross-sections of cable to the SINVERT PVS inverter. Various sizes are available.

- SINVERT PVS WeatherStation 200

  The WeatherStation 200 acquires data about the weather at the photovoltaic plant site. This weather data comes from connected sensors.

- SINVERT PVS ComBox 100 and SINVERT PVS ComBox 200

  The ComBox is used for communication between SINVERT PVS inverters and suitable network-enabled components.

  With the ComBox 200, inverter data can be transferred to a Web portal.

- SINVERT PVS ControlBox 300

  The purpose of the SINVERT PVS ControlBox 300 is to regulate the active and reactive power of a photovoltaic plant containing SINVERT PVS inverters and to ensure compliance with legal requirements (according to the current amendment of the Renewable Energy Act (EEG), in force since January 2009).

  The BDEW guideline "Generating Plants in the Medium-Voltage Grid" stipulates this requirement for all systems feeding in at the medium-voltage level. Its primary benefit is that it enables grid operators to limit the output of the plant by remote control in accordance with §6 of the Renewable Energy Sources Act 2009.

Dimensioning software

- SINVERT Select

  SINVERT Select is a free program designed to facilitate the dimensioning, analysis and optimization of SINVERT inverters for photovoltaic plants with outputs from a few kilowatts up to the megawatt range.

Monitoring and parameterization software

- SINVERT ConfigTool

  SINVERT ConfigTool is a free software program designed for configuring, parameterizing, and diagnosing inverters for photovoltaic installations.

- WinCC

  With our WinCC SCADA system, we offer you user-friendly monitoring and control of your entire photovoltaic plant.

Accessories

- Fan shrouds

Reference

For additional information, please refer to the associated operating instructions in the Industry Online Support (http://support.automation.siemens.com/WW/view/en/46183609/133300).

Grid management

4

4.1 Grid management in the case of SINVERT PVS

The following options are available for complying with requirements regarding grid safety management:

- Parameterization of the functions in the SINVERT PVS inverter

  The functions/specifications can be set manually via parameters in the SINVERT PVS inverter.

- Parameterization of the functions using the SINVERT PVS ControlBox

  The SINVERT PVS ControlBox is used to control the SINVERT PVS inverters of a PV plant. You can find more information in the SINVERT ControlBox operating instructions on the Internet in the Industry Online Support (http://support.automation.siemens.com).

Note

SINVERT PVS ControlBox

If communication between the SINVERT PVS ControlBox and the SINVERT PVS inverter fails, the SINVERT PVS ControlBox generates a fault message that is sent to the Scada system. The SINVERT PVS inverter continues to operate with the specifications it had before the communication failure.

Technical requirements of the inverter

The grid requirements are divided into static grid support, decoupling protection, and dynamic grid support.

To meet the requirements of grid operators, you also require a plant controller such as a SINVERT PVS ControlBox, in addition to the functions in the SINVERT PVS inverter.

The following static grid support functions are fulfilled by SINVERT PVS:

Function	Inverter	ControlBox
Static grid support		
Active power control		
• To fixed setpoint	✓	✓
• According to frequency P = f(f)[1)]	✓	✓
• According to output voltage P = f(U)	✓	-
• Active power limitation during the switch-on operation	✓	-
• By means of signals from the power utility	-	✓
Reactive power control		
• To absolute Q setpoint	✓	-
• To relative Q setpoint	✓	✓
• To absolute cos φ setpoint	✓	✓
• According to time of day Q(t)[2)]	✓	✓
• By means of cos φ (t) according to time of day[2)]	✓	✓
• According to output voltage Q = f(U)[2)]	✓	✓
• According to cos φ (P)[2)]	✓	✓
• By means of signals from the power utility	-	✓
Decoupling protection		
Frequency monitoring	✓	-
Voltage monitoring	✓	-
Feed-in conditions	✓	-
Dynamic grid support		
Low voltage ride through (LVRT)	✓	-
High voltage ride through (HVRT)	✓	-
Fault ride through (FRT)	✓	-

[1)] The function must only be activated either in the inverter or in the ControlBox.

[2)] If a ControlBox is used, the function must be deactivated in the inverter.

Interface to the grid operator

Communication with the grid operator is achieved via a SINVERT PVS ControlBox. The ControlBox measures at the infeed point and controls the individual inverters in accordance with the grid operator's specifications.

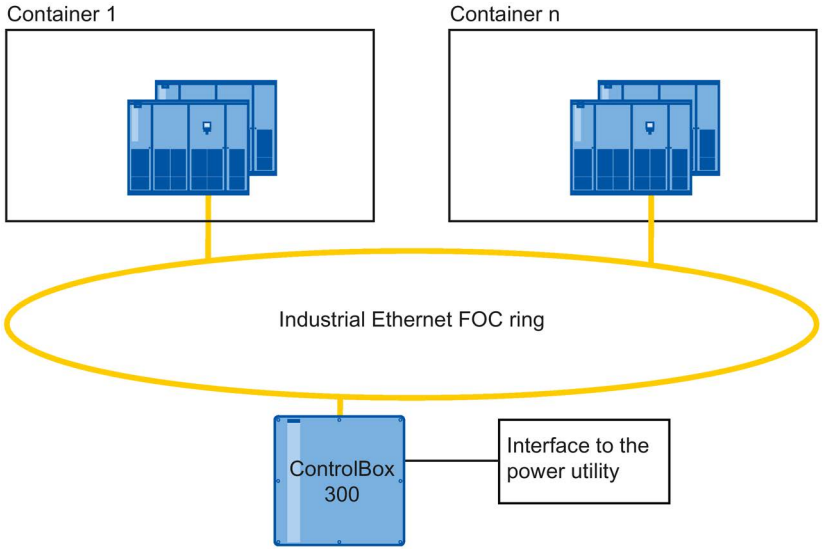


Figure 4-1 Interface to the power utility

4.2 Static grid support

4.2.1 Active power control

Methods of controlling the active power

There are four different functions for controlling the active power in the SINVERT PVS inverter:

- Active power control to fixed setpoint (Page 39)
- Active power control according to frequency P=f(f) (Page 40)
- Active power control in accordance with output voltage P = f(U) (Page 45)
- Active power control during the switch-on operation (Page 46)

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, the function "Fixed setpoint" must be selected since the fixed setpoint is specified by the SINVERT PVS ControlBox.

Settings

You set the individual active power control functions under the Service menu item "Grid Parameters Menu".

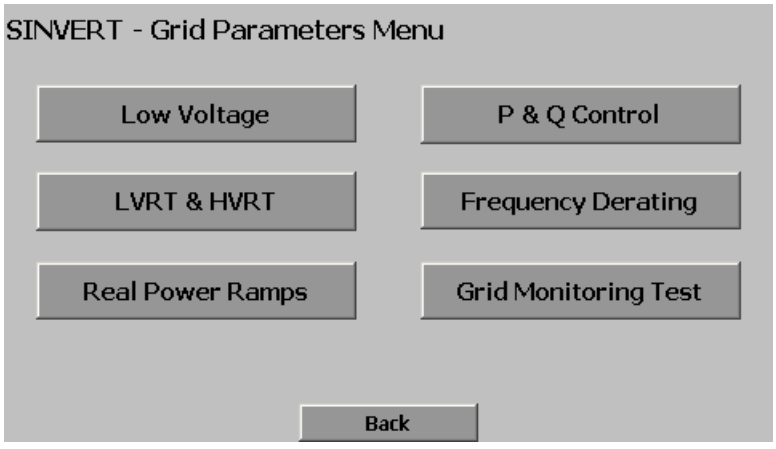


Figure 4-2 Grid Parameters Menu

The menu item "P & Q Control" contains the settings for the following control conditions:

- Active power control to fixed setpoint (Page 39)
- Active power control in accordance with output voltage P = f(U) (Page 45)

You will find the settings for the Active power control during the switch-on operation (Page 46) under the menu item "Active Power Ramps".

You will find the settings for the Active power control according to frequency P=f(f) (Page 40) under the menu item "Frequency Derating".

4.2.1.1 Active power control to fixed setpoint

Function

The active power of the SINVERT PVS inverter can be limited to a fixed setpoint P_{max}. The setting is made as a percentage of the maximum rated power. This function is also used by the SINVERT PVS ControlBox to implement the grid operator's specifications.

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, this value is overwritten cyclically.

Settings

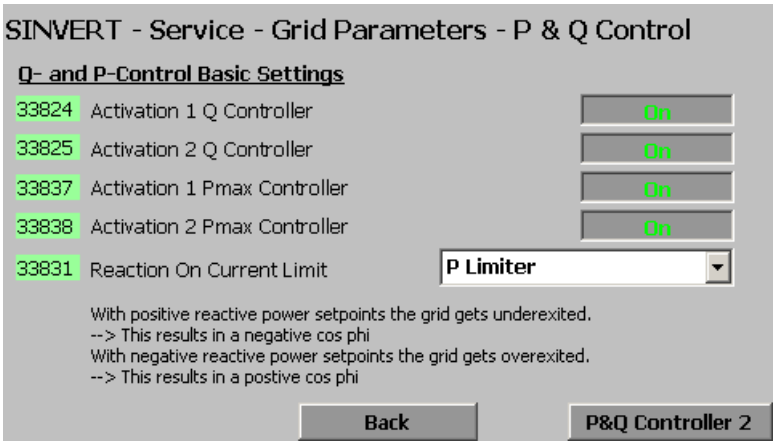

SINVERT - Service - Grid Parameters - P & Q Control
Q- and P-Control Basic Settings
33824 Activation 1 Q Controller
On
33825 Activation 2 Q Controller
On
33837 Activation 1 Pmax Controller
On
33838 Activation 2 Pmax Controller
On
33831 Reaction On Current Limit
P Limiter
With positive reactive power setpoints the grid gets underexited.
--> This results in a negative cos phi
With negative reactive power setpoints the grid gets overexited.
--> This results in a postive cos phi
Back
P&Q Controller 2

Figure 4-3 P & Q control [1/9]

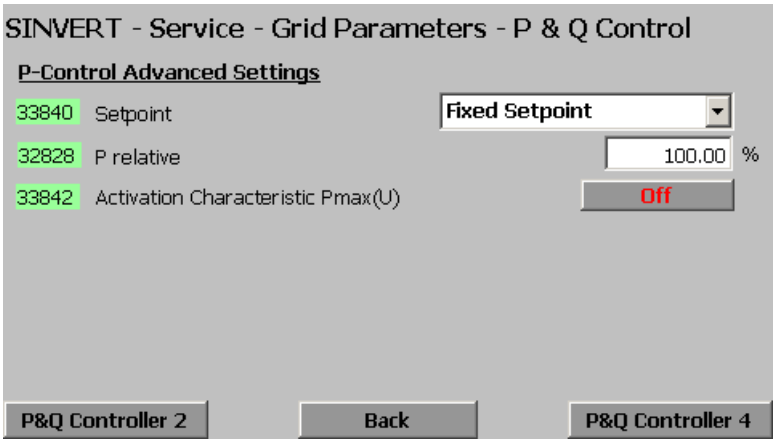


Figure 4-4 P & Q control [3/9]

You activate or deactivate the active power control to a fixed setpoint using the following three parameters:

Parameter number	Parameters	Range	Increment
33837	Activation 1 of Pmax controller	On Off	-
33838	Activation 2 of Pmax controller	On Off	-

For activating the active power control to a fixed setpoint, both parameters must be set to "On".

For "Active power control to fixed setpoint", enter the setpoint in the field p32828.

Parameter number	Parameters	Range	Increment
33828	P relative	0 … 100% of the rated power	1 %

4.2.1.2 Active power control according to frequency P=f(f)

Function

If the power grid contains more power than is currently used, the grid frequency increases. The SINVERT PVS inverters detect an increase in the grid frequency and can reduce the active power dependent on frequency.

The relationship between the output power and the grid frequency is predefined via the P(f) curve.

If a parameterized frequency value f_1 is exceeded, the active power P_f present at this time is registered and thereafter used as the reference value for the P=f(f) curve.

While the frequency in the grid increases, the SINVERT PVS inverter supplies an output power dependent on the level of the current frequency along the curve. The rise in the PP=f(f) curve can be parameterized on the inverter by means of the gradient G.

If the frequency exceeds a parameterized frequency limit f_H, see Chapter Frequency monitoring (Page 74), the SINVERT PVS inverter switches off.

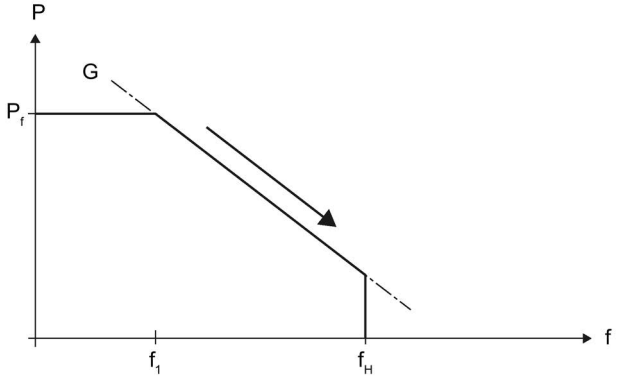


Figure 4-5 Active power control according to frequency P=f(f)

Resumption of normal operation:

There are three modes of resuming normal operation in the the case of frequency derating:

1. Frequency derating without hysteresis

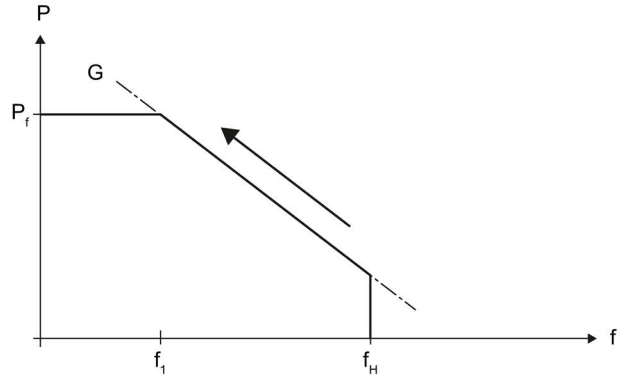


Figure 4-6 Active power control according to frequency P=f(f) without hysteresis

As long as the frequency does not drop below the limit f_1 again, the SINVERT PVS inverter supplies an output power dependent on the level of the current frequency along the curve. As soon as the frequency drops below the limit f_1 in the grid, the SINVERT PVS inverter resumes normal operation. It now feeds in the maximum possible power again, provided no other specifications are present.

2. Frequency derating with hysteresis and start frequency

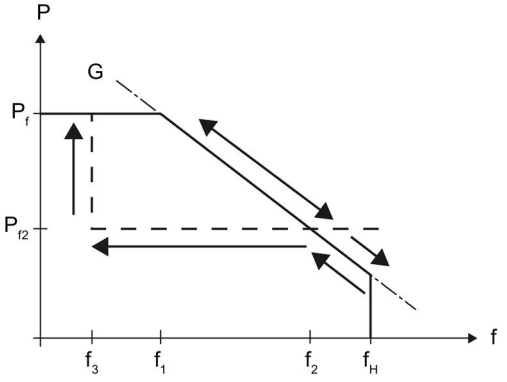


Figure 4-7 Active power control according to frequency P=f(f) with hysteresis and start frequency

If a second limit frequency f_2 (parameterizable) is exceeded, the inverter no longer follows the curve, and instead remains at a constant output power P_{f2}(determined by the curve) until the frequency has dropped below the end frequency for resuming normal operation f_3 (parameterizable).

3. Frequency derating with hysteresis and without start frequency

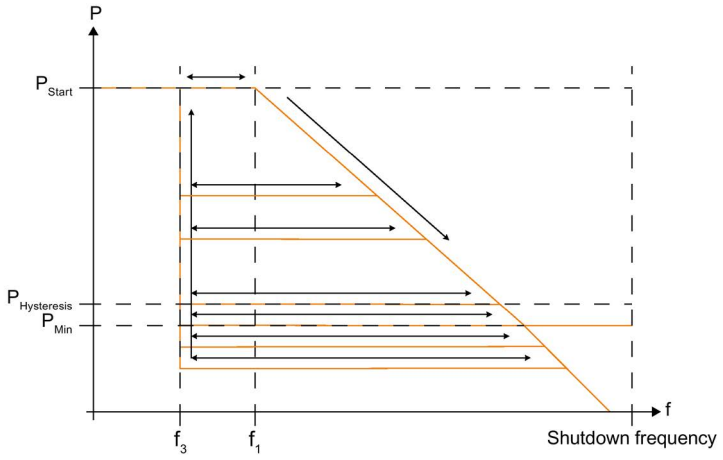


Figure 4-8 Active power control according to frequency P=f(f) with hysteresis and start frequency

Contrary to active power control according to frequency P=f(f) with hysteresis and start frequency, the second limit frequency f_2 is not required. The inverter generally no longer follows the curve in the case of frequency derating, and instead remains at the minimum calculated output power P (determined via the curve) until the final frequency for resuming normal operation f_3 (parameterizable) has been undershot.

Only one mode is parameterized for frequency-dependent active power reduction. You set all parameters here, regardless of which mode is used.

Parameterization of a minimum holding power

A minimum holding power can be parameterized additionally for modes 1 and 3. Some Grid Codes demand this. If this function is activated, the inverter will not reduce the output power below the parameterized holding power. If the frequency f nevertheless continues to rise, the inverter will be switched off when the frequency point f_H is reached.

Note

The functions can be deactivated if required.

Settings

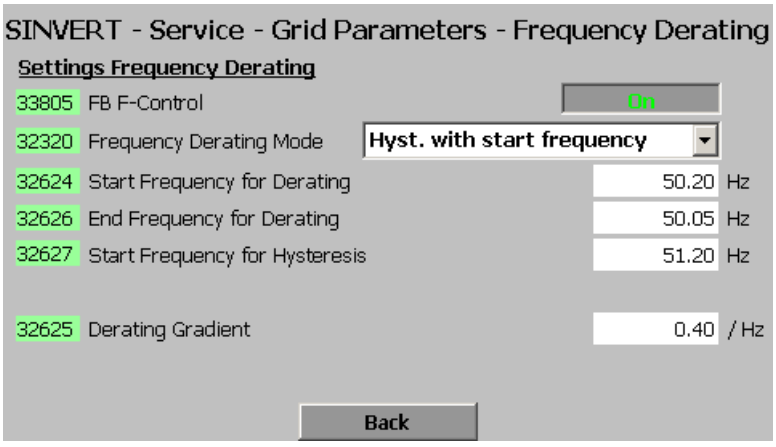


Figure 4-9 Frequency derating [1/1]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
33805	Activation of FB F-Control	On Off	-
32320	Frequency Derating Mode	1. Hysteresis with start frequency 2. Hysteresis without start frequency 3. No hysteresis	-
32624	Limit frequency f_1	50 Hz: 47 ... 53 Hz 60 Hz: 57 ... 62 Hz	0.01 Hz
32627	Limit frequency f_2	50 Hz: 47 ... 53 Hz 60 Hz: 57 ... 62 Hz	0.01 Hz
32626	Limit frequency f_3	50 Hz: 47 ... 53 Hz 60 Hz: 57 ... 62 Hz	0.01 Hz
32625	Gradient G	0.1 ... 1.5[1) 2)]	0.01
-	Activate / deactivate minimum power point	Hold power Reduce power	-
32325	Minimum power point	0…2500 kW	0.1 kW

1) Calculation of the gradient (without hysteresis): $G = P_f / (f_n - f_1)$; where f_n is the crossing point of the derating curve and the x axis

2) Calculation of the gradient (with hysteresis): $G = (P_f - P_{f2}) / (f_2 - f_1)$

You can find the setting options for f_H in Chapter Frequency monitoring (Page 74).

Example of setting a frequency reduction without hysteresis

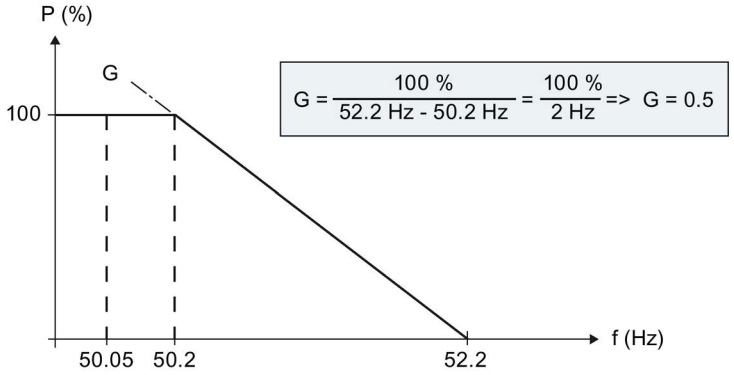


Figure 4-10 Example of setting a frequency reduction without hysteresis

P_f = 100%

f_1 = 50.2 Hz

$f_2 > f_H \Rightarrow f_2 = f_H$ +0.1 Hz

f_3 = 50.05 Hz

$f_H > 52.2\ Hz \Rightarrow f_H = 52.2\ Hz + 0.1\ Hz$

Example of setting a frequency reduction with hysteresis

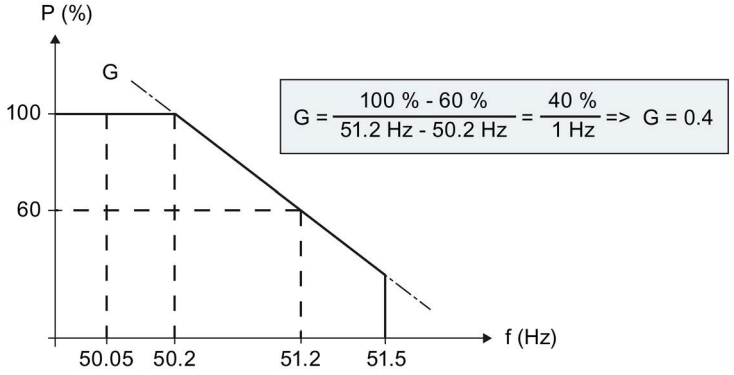


Figure 4-11 Example of setting a frequency reduction with hysteresis

P_f = 100%

P_{f2} = 60%

f_1 = 50.2 Hz

f_2 = 51.2 Hz

f_3 = 50.05 Hz

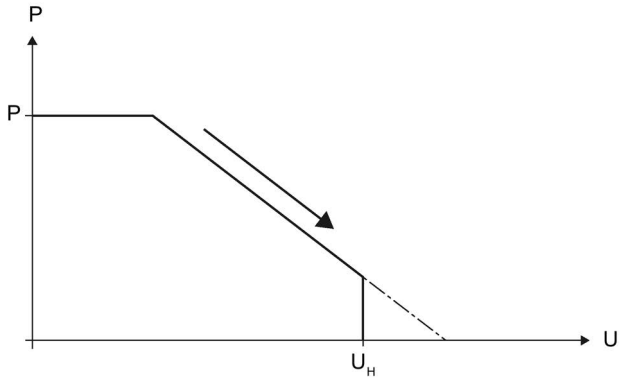
f_H = 51.5 Hz

4.2.1.3 Active power control in accordance with output voltage P = f(U)

Function

The active power of the SINVERT PVS inverter can be reduced dependent on the output voltage.

If the voltage exceeds a parameterized voltage limit U_H, see Chapter Voltage monitoring (Page 76), the SINVERT PVS inverter switches off.



P_U Actual active power

Figure 4-12 Active power control according to output voltage P = f(U)

Note

The function can be deactivated if required.

Settings

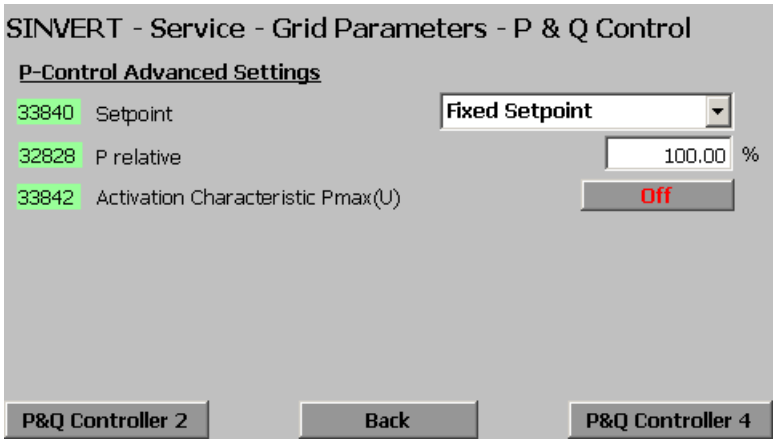


Figure 4-13 P & Q control [3/9]

The function can be activated or deactivated via the following parameters:

Parameter number	Parameters	Range	Increment
33842	Activation of characteristic Pmax(U)	On Off	-

You can find the setting options for U_H in Chapter Voltage monitoring (Page 76).

4.2.1.4 Active power control during the switch-on operation

Function

To avoid sudden variations in active power on the grid resulting from fast switch-on of the PV plant, the SINVERT PVS inverter can increase its output via a parameterizable ramp. The following options can be parameterized to stipulate when the output is to be increased via a ramp:

- Never
- Only following grid fault
- At every start operation

The increase of the ramp over a gradient until the full rated active power P_n is reached can continue to be parameterized.

The increase in the ramp is independent of the actually present active power. The active power increases along the ramp up to the existing PV array power.

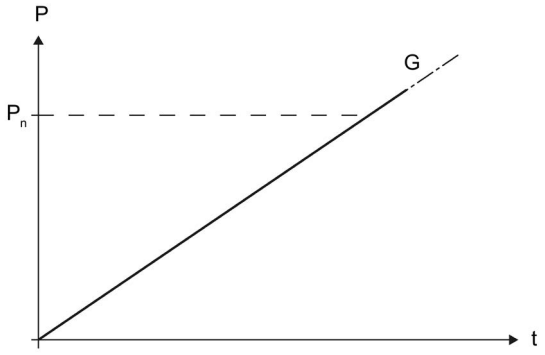


Figure 4-14 Active power control during the switch-on operation

Settings

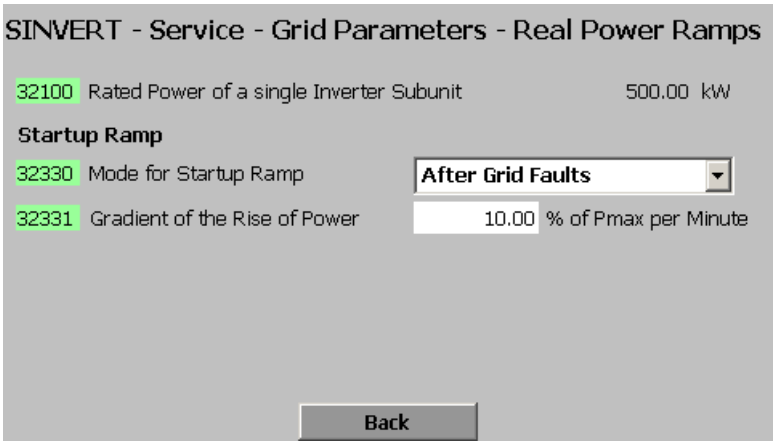

SINVERT - Service - Grid Parameters - Real Power Ramps
32100 Rated Power of a single Inverter Subunit
500.00 kW
Startup Ramp
32330 Mode for Startup Ramp
After Grid Faults
32331 Gradient of the Rise of Power
10.00 % of Pmax per Minute
Back

Figure 4-15 Active power ramps [1/1]

The function can be set via the following parameter:

Parameter number	Parameters	Range	Increment
32330	Type of ramp	• No ramp (ramp deactivated) • Ramp after grid fault (standard) • INV start always with ramp	-
32331	Gradient of the increase	1 ... 100% of P_{max} per minute	1 %

4.2.2 Reactive power control

Methods of controlling the reactive power

The increasingly strong trend towards integration of distributed generating plants into distribution grids results in the rising challenge of voltage stability. It is possible to influence the grid voltage by means of the reactive power. The SINVERT PVS inverters can be operated with a reactive power corresponding to a power factor cosφ = 0.8 **inductive** (low voltage / medium voltage) to cos φ = 0.8 **capacitive**.

Note

Negative values correspond to an inductive reactive power (overexcited operation) and positive values to a capacitive reactive power (underexcited operation).

Reactive power control can be specified in accordance with five different functions:

- Reactive power control to absolute setpoint of Q or cos φ
- Reactive power control according to time of day Q(t) or cos φ (t)
- Reactive power control according to output voltage Q=f(U)
- Reactive power control according to active power cos φ (P)
- Reactive power control to relative fixed setpoint of Q_{max}

In general, a distinction must be made between two different bases when providing reactive power:

- Reactive power control on the basis of the power factor cos φ
- Reactive power control on the basis of reactive power Q

Different functions are available depending on the basis selected.

Reactive power control on the basis of the power factor cos φ

For power factor cos φ (setpoint type), you can select one of the following functions (setpoint source):

- Fixed setpoint
- cos φ (P) curve
- cos φ (t) curve

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, the function "Fixed setpoint" must be selected since the fixed setpoint is specified by the SINVERT PVS ControlBox.

Reactive power control on the basis of reactive power Q

For reactive power Q (setpoint type), you can select one of the following functions (setpoint source):

- Absolute fixed setpoint
- Q (U) curve
- Q (t) curve
- Relative fixed setpoint

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, the function "Absolute fixed setpoint" must be selected since the fixed setpoint is specified by the SINVERT PVS ControlBox.

Settings

You set the setpoint source and the setpoint type for reactive power control on the first page of the menu "P & Q Control".

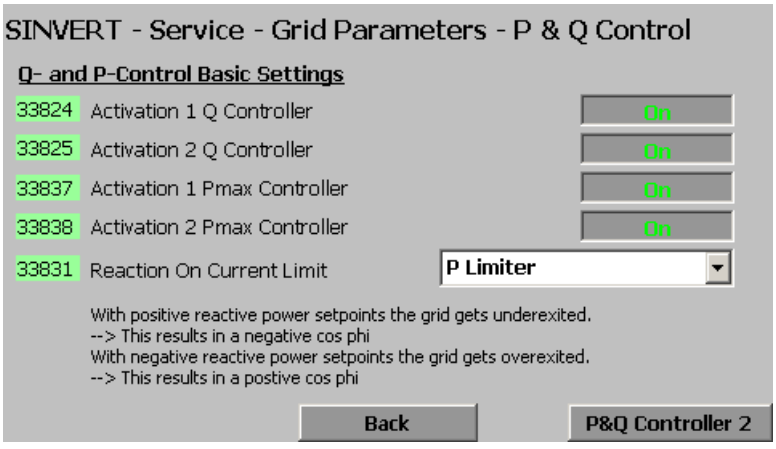

SINVERT - Service - Grid Parameters - P & Q Control
Q- and P-Control Basic Settings
33824 Activation 1 Q Controller
On
33825 Activation 2 Q Controller
On
33837 Activation 1 Pmax Controller
On
33838 Activation 2 Pmax Controller
On
33831 Reaction On Current Limit
P Limiter
With positive reactive power setpoints the grid gets underexited.
--> This results in a negative cos phi
With negative reactive power setpoints the grid gets overexited.
--> This results in a postive cos phi
Back
P&Q Controller 2

Figure 4-16 P & Q control [1/9]

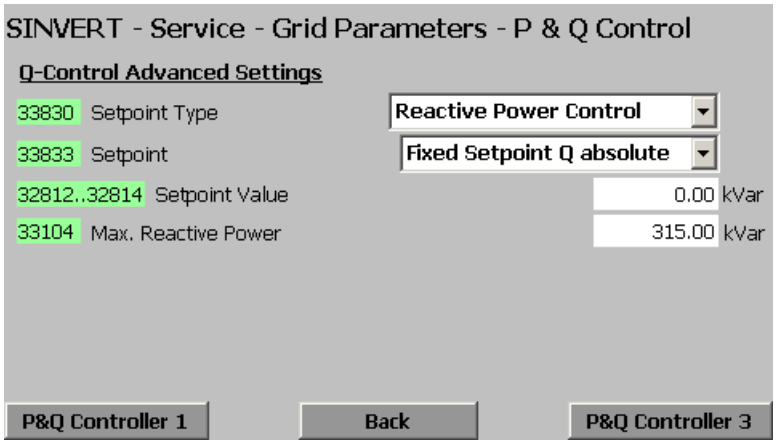


Figure 4-17 P & Q control [2/9]

You activate / deactivate the respective active power control using the following three parameters:

Parameter number	Parameters	Range	Increment
33824	Activation 1 of Q controller	• On • Off	-
33825	Activation 2 of Q controller	• On • Off	-
33830	Setpoint type	• Reactive power • cos(phi)	-
33833	Setpoint	• Fixed setpoint • f(U)/f(P) characteristic • Time-based setpoint • Relative setpoint for Q control	-

For activating the active power control to a fixed setpoint, p33824 and p33825 must be set to "On".

4.2.2.1 Reactive power control to fixed setpoint Q absolute

Function

The reactive power of the SINVERT PVS inverter can be set to a fixed setpoint.

The inverter can provide reactive power for voltage support/reduction. This can be achieved either on the basis of a fixed reactive power value or on the basis of a fixed power factor.

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, this value is overwritten cyclically.

Settings

1. Set the setpoint type "Reactive power control" via selection field p33830.
2. Set the setpoint source "Fixed setpoint Q absolute" via selection field p33833.
3. Enter the setpoints as follows:

   If no SINVERT PVS ControlBox is used, enter the setpoint for the reactive power in field p32813 if the setpoint type "Reactive Power Control" is selected.

   Note

   Negative values correspond to an inductive reactive power (overexcited operation) and positive values to a capacitive reactive power (underexcited operation).

4. Enter the setpoint for the maximum reactive power in field p33104.

   If the reactive power must be limited to a lower value than the maximum possible value, you can enter this value here. Otherwise, the default value should remain.

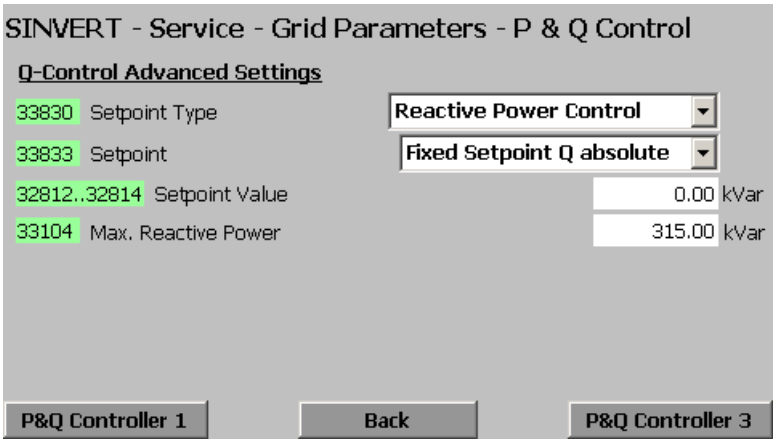


Figure 4-18 P & Q control [2/9]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
33833	Selection of setpoint source	• Fixed setpoint Q absolute • Q(t) • Fixed setpoint Q relative	-
32813	Fixed setpoint of reactive power	Dependent on the inverter type, see table below	1 kVAR
33104	Maximum reactive power	Dependent on the inverter type, see table below	1 kVAR

Inverter type	Reactive power range
PVS500 / PVS1000 / PVS1500 / PVS2000	- 300 … + 300 kVAR
PVS525 / PVS1050 / PVS1575 / PVS2100	- 315 … + 315 kVAR
PVS585 / PVS1170 / PVS1755 / PVS2340	- 351 … + 351 kVAR
PVS600 / PVS1200 / PVS1800 / PVS2400	- 360 … + 360 kVAR
PVS630 / PVS1260 / PVS1890 / PVS2520	- 378 … + 378 kVAR

4.2.2.2 Reactive power control to fixed setpoint Q relative

Function

The reactive power of the SINVERT PVS inverter can be set to a relative fixed setpoint.

The inverter can provide reactive power for voltage support/reduction. This can be achieved either on the basis of a fixed reactive power value or on the basis of a fixed power factor.

Settings

1. Set the setpoint type "Reactive power control" via selection field p33830.
2. Set the setpoint source "Fixed setpoint Q relative" via selection field p33833.
3. Enter the setpoints as follows:

   If no SINVERT PVS ControlBox is used, enter the setpoint for the reactive power in the field p32814 if the setpoint type "Reactive power control" is selected.

   Note

   Negative values correspond to an inductive reactive power (overexcited operation) and positive values to a capacitive reactive power (underexcited operation).

4. Enter the setpoint for the maximum reactive power in field p33104.

   If the reactive power must be limited to a lower value than the maximum possible value, you can enter this value here. Otherwise, the default value should remain.

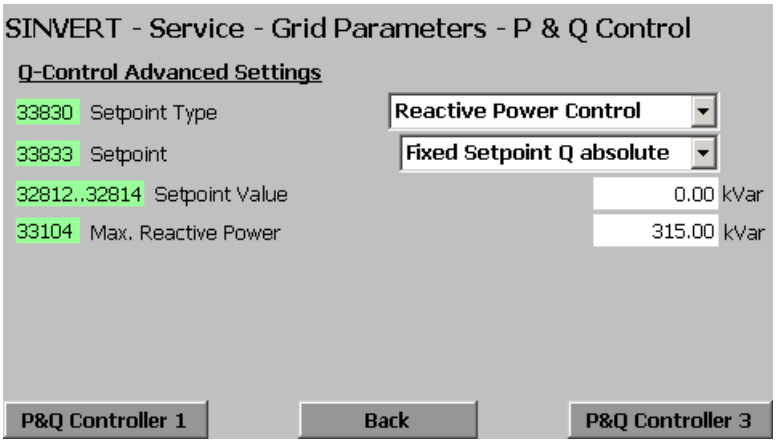


Figure 4-19 P & Q control [2/9]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
33833	Selection of setpoint source	• Fixed setpoint Q absolute • Q(t) • Fixed setpoint Q relative	-
32814	Fixed setpoint of reactive power	Dependent on the inverter type, see table below	1 kVAR
33104	Maximum reactive power	Dependent on the inverter type, see table below	1 kVAR

Inverter type	Reactive power range
PVS500 / PVS1000 / PVS1500 / PVS2000	- 300 … + 300 kVAR
PVS525 / PVS1050 / PVS1575 / PVS2100	- 315 … + 315 kVAR
PVS585 / PVS1170 / PVS1755 / PVS2340	- 351 … + 351 kVAR
PVS600 / PVS1200 / PVS1800 / PVS2400	- 360 … + 360 kVAR
PVS630 / PVS1260 / PVS1890 / PVS2520	- 378 … + 378 kVAR

4.2.2.3 Reactive power control to fixed setpoint cos phi

Function

The reactive power of the SINVERT PVS inverter can be set to a fixed setpoint.

The inverter can provide reactive power for voltage support/reduction. This can be achieved either on the basis of a fixed reactive power value or on the basis of a fixed power factor.

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, this value is overwritten cyclically.

Settings

1. Set the setpoint type "cos phi" via selection field p33830.
2. Set the setpoint source "Fixed setpoint" via selection field p33833.
3. Enter the setpoints as follows:

   If no SINVERT PVS ControlBox is used, enter the setpoint for the reactive power in the field p32812 if the setpoint type "Reactive power control" is selected.

   Note

   Negative values correspond to an inductive reactive power (overexcited operation) and positive values to a capacitive reactive power (underexcited operation).

4. Enter the setpoint for the maximum reactive power in field p33104.

   If the reactive power must be limited to a lower value than the maximum possible value, you can enter this value here. Otherwise, the default value should remain.

5. If setpoint type "cos phi" is selected, enter the minimum (p32615) and maximum (p32616) cos phi setpoint.

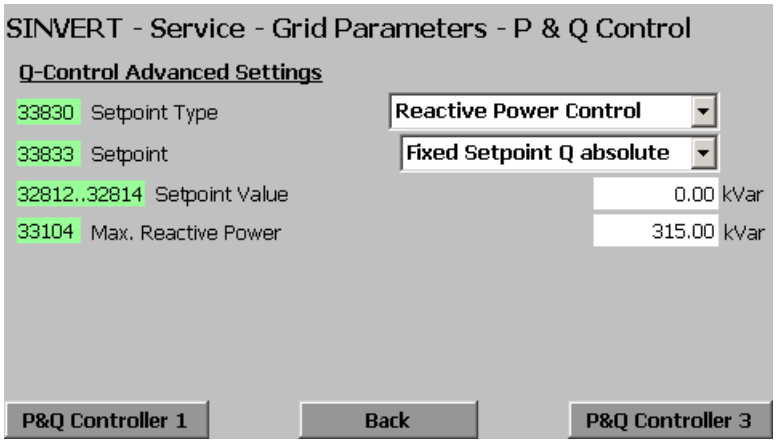


Figure 4-20 P & Q control [2/9]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
33833	Selection of setpoint source	• Fixed setpoint • cos φ(t) • cos φ(P)	-
32812	Power factor	-0.8 … 1 … 0.8	0.01
33104	Maximum reactive power	Dependent on the inverter type, see table below	1 kVAR

Inverter type	Reactive power range
PVS500 / PVS1000 / PVS1500 / PVS2000	- 300 … + 300 kVAR
PVS525 / PVS1050 / PVS1575 / PVS2100	- 315 … + 315 kVAR
PVS585 / PVS1170 / PVS1755 / PVS2340	- 351 … + 351 kVAR
PVS600 / PVS1200 / PVS1800 / PVS2400	- 360 … + 360 kVAR
PVS630 / PVS1260 / PVS1890 / PVS2520	- 378 … + 378 kVAR

4.2.2.4 Reactive power control according to time of day Q(t)

Function

This function enables different reactive power values to be made available depending on the time of day. 24 interpolation points can be parameterized for this purpose.

An interpolation point consists of a reactive power Q and a time t.

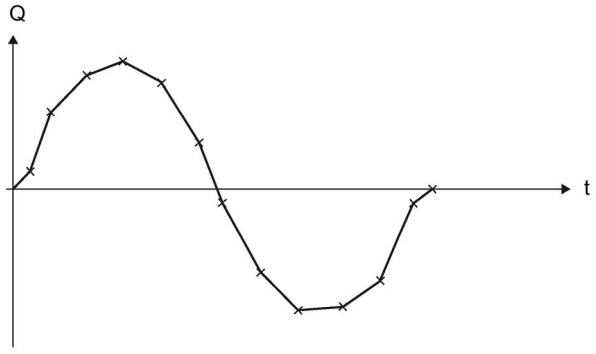


Figure 4-21 Reactive power control according to time of day Q(t)

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, this value is overwritten cyclically.

Note

This function can be deactivated if required.

Settings

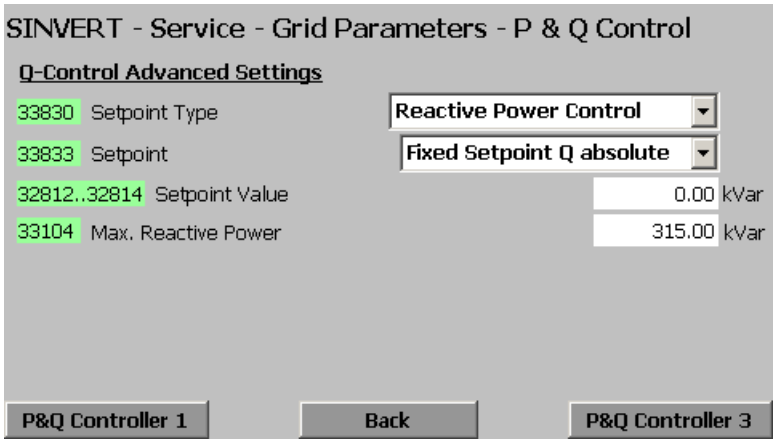


Figure 4-22 P & Q control [2/9]

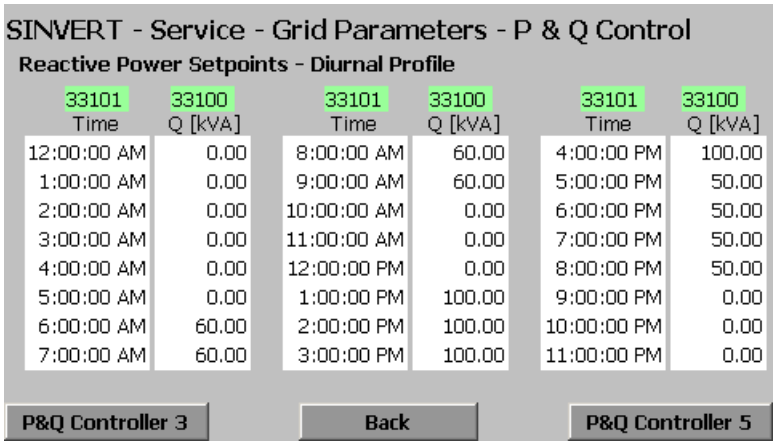


Figure 4-23 P & Q control [4/9]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
33101	t_0 ... t_{23}	00:00:00 ... 23:59:59	1 s
33100	Reactive power Q	Dependent on the inverter type, see table below	0.01 kVAR

Inverter type	Reactive power range
PVS500 / PVS1000 / PVS1500 / PVS2000	- 300 … + 300 kVAR
PVS525 / PVS1050 / PVS1575 / PVS2100	- 315 … + 315 kVAR
PVS585 / PVS1170 / PVS1755 / PVS2340	- 351 … + 351 kVAR
PVS600 / PVS1200 / PVS1800 / PVS2400	- 360 … + 360 kVAR
PVS630 / PVS1260 / PVS1890 / PVS2520	- 378 … + 378 kVAR

Note

System time

The system time on the SINVERT PVS inverter must be correctly set.

Note

SIMOTION D425 time

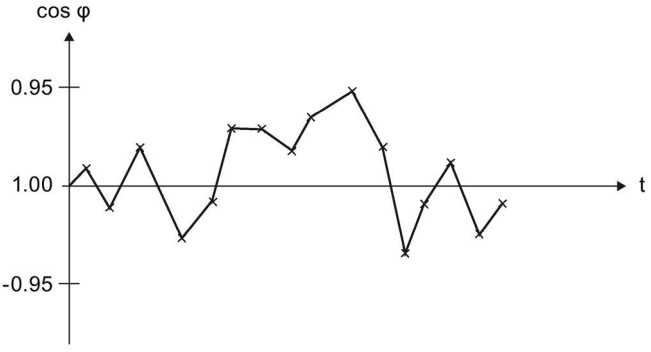
Please note the possible time deviation of the SIMOTION D425. You can find information on the accuracy of the real-time clock of the SIMOTION D425 in the SIMOTION D4x5 manual. You can find the SIMOTION D4x5 manual in the Industry Online Support (http://support.automation.siemens.com).

4.2.2.5 Reactive power control by means of cos φ (t) according to time of day

Function

This function enables different reactive power values to be made available depending on the time of day. 24 interpolation points can be parameterized for this purpose.

An interpolation point consists of a cos φ value and a time.



-0,8 … -0,99999	Overexcited (capacitive reactive power is used, inductive reactive power is supplied)
0,8 … 1,0	Underexcited (inductive reactive power is used, capacitive reactive power is supplied)

Figure 4-24 Reactive power control by means of cos φ (t) according to time of day

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, this value is overwritten cyclically.

Note

This function can be deactivated if required.

Settings

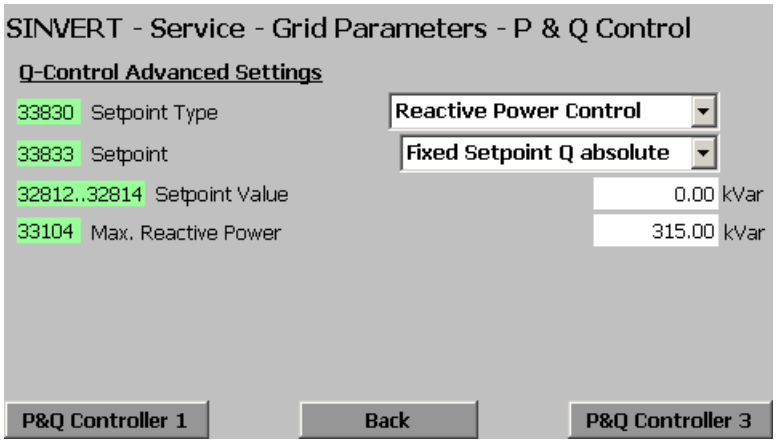


Figure 4-25 P & Q control [2/9]

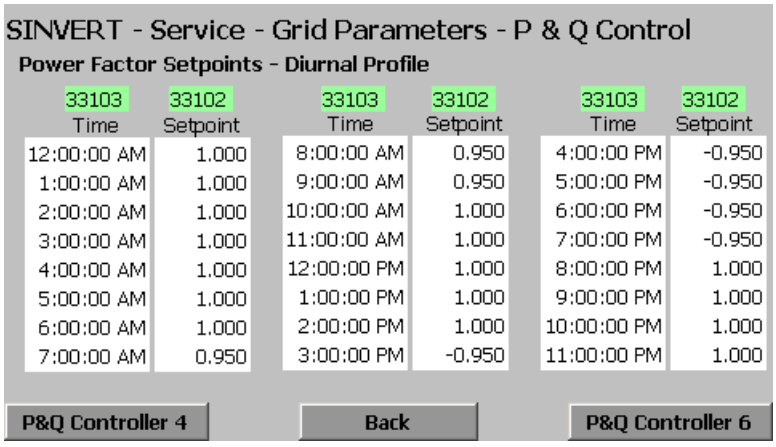


Figure 4-26 P & Q control [5/9]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
33103	t_0 ... t_{23}	00:00:00 ... 23:59:59	1 s
33102	cos φ_1 ... cos φ_{23}	$0{,}8_{ind}$ ... 1 ... 0.8_{cap}	0,001

Note

Setpoints (p33102)

Negative values correspond to an inductive reactive power (overexcited operation) and positive values to a capacitive reactive power (underexcited operation).

Note

System time

The system time on the SINVERT PVS inverter must be correctly set.

Note

SIMOTION D425 time

Please note the possible time deviation of the SIMOTION D425. You can find information on the accuracy of the real-time clock of the SIMOTION D425 in the SIMOTION D4x5 manual. You can find the SIMOTION D4x5 manual in the Industry Online Support (http://support.automation.siemens.com).

4.2.2.6 Reactive power control in accordance with output voltage Q=f(U)

Function

The SINVERT PVS inverters can feed voltage-level-dependent reactive power into the grid (reactive power/voltage curve Q(U)).

The curve can be parameterized via two voltage limit values U_1 and U_2. The voltage limits are specified as percentages of the rated voltage. The maximum reactive power Q_1 (= - Q_2) can also be parameterized.

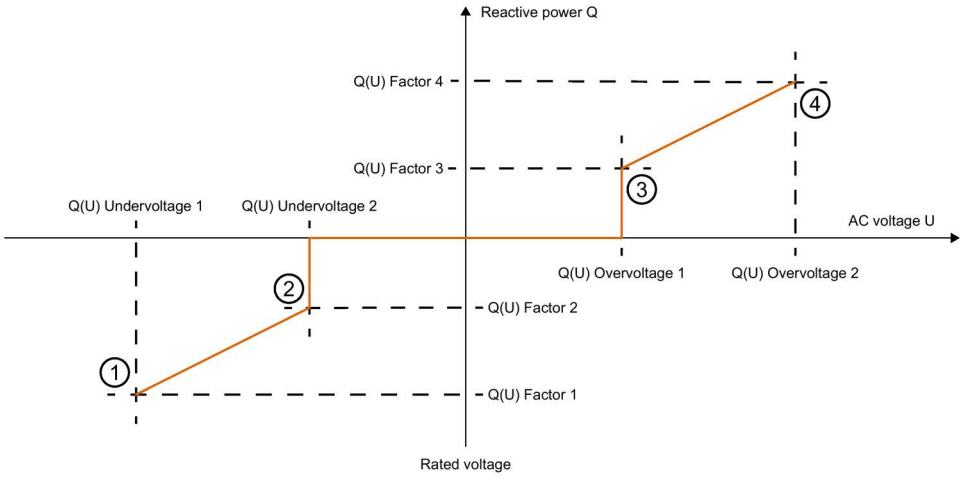


Figure 4-27 Reactive power control according to output voltage Q=f(U)

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, this value is overwritten cyclically.

Note

The function can be deactivated if required.

Settings

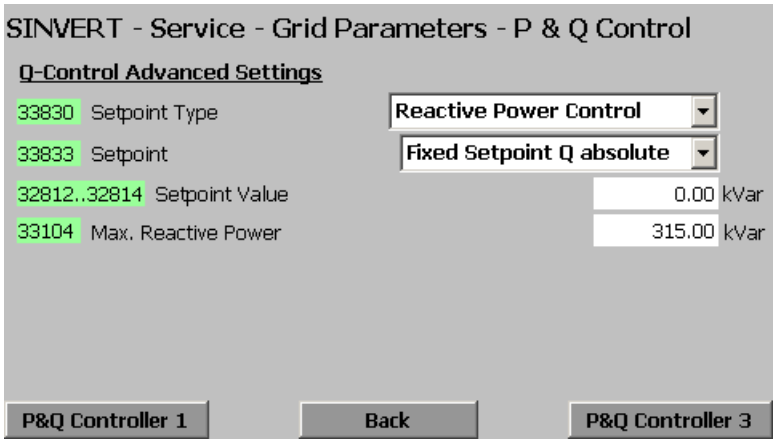


Figure 4-28 P & Q control [2/9]

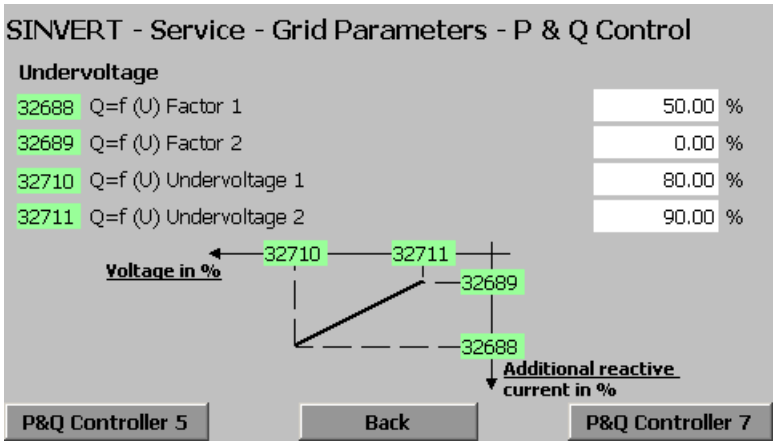


Figure 4-29 P & Q control [6/9]

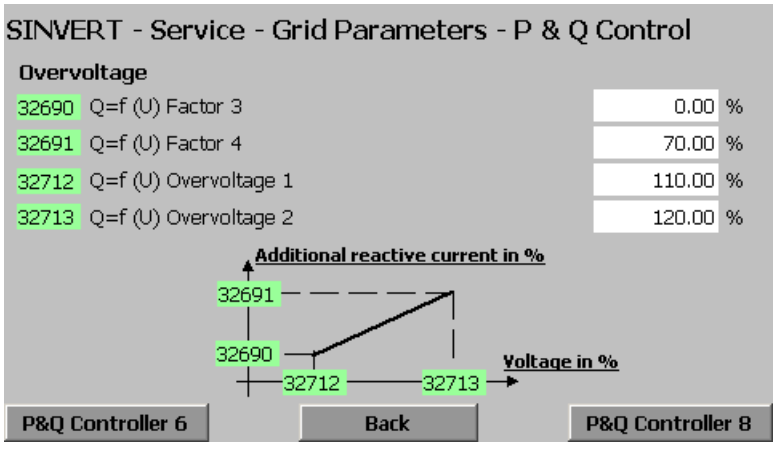


Figure 4-30 P & Q control [7/9]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
32688	Lower reactive power value Q_2	0 … 100% of the maximum reactive power	0.01 %
32689	Lower reactive power value Q_1	0 … 100% of the maximum reactive power	0.01 %
32690	Upper reactive power value Q_3	0 … 100% of the maximum reactive power	0.01 %
32691	Upper reactive power value Q_4	0 … 100% of the maximum reactive power	0.01 %
32710	Lower voltage limit value U_1	0 … 100 % of the AC rated voltage	0.01 %
32711	Lower voltage limit value U_1	0 … 100 % of the AC rated voltage	0.01 %
32712	Upper voltage limit value U_1	100 ... 200 % of the AC rated voltage	0.01 %
32713	Upper voltage limit value U_2	100 ... 200 % of the AC rated voltage	0.01 %

Inverter type	Reactive power range
PVS500 / PVS1000 / PVS1500 / PVS2000	- 300 … + 300 kVAR
PVS525 / PVS1050 / PVS1575 / PVS2100	- 315 … + 315 kVAR
PVS585 / PVS1170 / PVS1755 / PVS2340	- 351 … + 351 kVAR
PVS600 / PVS1200 / PVS1800 / PVS2400	- 360 … + 360 kVAR
PVS630 / PVS1260 / PVS1890 / PVS2520	- 378 … + 378 kVAR

4.2.2.7 Reactive power control according to active power cos φ (P)

Function

The SINVERT PVS inverters can feed reactive power into the grid dependent on the level of the actual active power P (power factor/power curve cos φ (P)). The curve can be parameterized via two limit values. The limit values are specified as percentages of the rated power. The maximum cos φ_1 (= - cos φ_2) can also be parameterized.

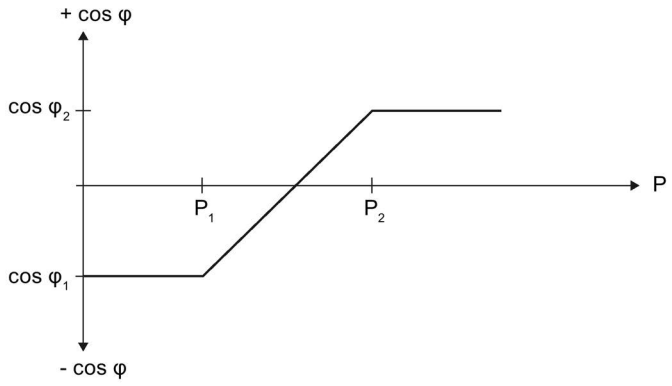


Figure 4-31 Reactive power control according to cos φ (P)

Note

SINVERT PVS ControlBox

When using the SINVERT PVS ControlBox, this value is overwritten cyclically.

Note

The function can be deactivated if required.

Settings

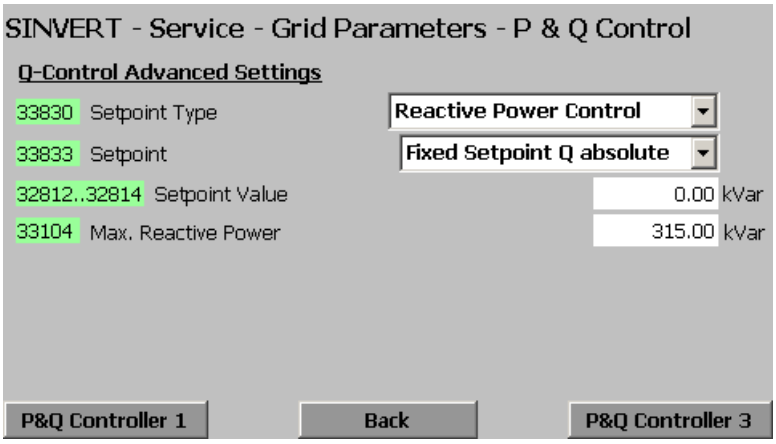


Figure 4-32 P & Q control [2/9]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
32661	Lower power tolerance limit	10.0 ... 100.0 % of the rated power	0.01 %
32660	Upper power tolerance limit	100.0 ... 140.0 % of the rated power	0.01 %
32615	Min. setpoint cos φ_1 (= - cos φ_2)	-0.9 ... -0.8	0.01
32616	Max. setpoint cos φ_1 (= - cos φ_2)	0,8 ... 1,0	0,01

4.3 Dynamic grid support

4.3.1 Behavior in the case of voltage dips (low voltage ride through)

Due to the growing spread of renewable energy forms, you must ensure that the inverter does not shut down immediately when brief voltage dips occur. The SINVERT PVS inverter has the ability to withstand brief voltage dips and remain on the grid. The shutdown behavior in the case of voltage dips can be set via the LVRT curve, see the chapter "Shutdown behavior in the event of voltage dips (Page 64)".

The SINVERT PVS inverter can continue to provide reactive current for voltage support during these voltage dips. The level of the reactive current can be set via the k factor depending on the depth of the grid voltage dip, see the chapter "Reactive current provision in the event of voltage dips (Page 67)".

4.3.2 Shutdown behavior in the event of voltage dips

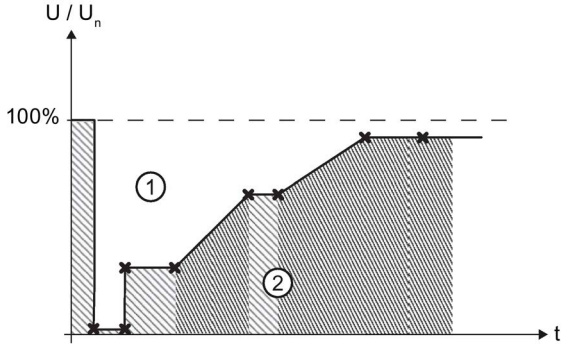
Function

The LVRT curve can be parameterized by means of up to 10 interpolation points. An interpolation point consists of a voltage level U / U_n and a time t during which the voltage level can be present before the SINVERT PVS inverter shuts down. Linear interpolation is carried out between the two interpolation points. The voltage level is calculated from the ratio of the actual voltage U to the rated voltage U_n.

Note

The function can be deactivated if required.

The limit curve shown in the figure represents a typical LVRT curve as defined by many grid operators.



① Range within which the inverter remains on the grid.
② Range (shaded) within which the inverter switches off.

Figure 4-33 LVRT curve

Settings

Note the following points when parameterizing the LVRT curve:

- The parameterized LVRT curve must correspond to the undervoltage protection settings. For this reason, parameterize two of the interpolation points identically to the entered limit values of the undervoltage monitor.

  See Chapter Voltage monitoring (Page 76).

- When parameterizing, all fields must be filled, but it is not absolutely necessary to use all available interpolation points.

  When using fewer than 10 interpolation points, the order of the entered interpolation is decisive since interpolation between the individual points is linear. For this reason, always enter the used interpolation points first. Then enter the values of the last interpolation point in the subsequent fields for the interpolation points that are not required.

  You will find an example in the figure below. The first four interpolation points (0 to 4) are used. All the subsequent fields (5 to 9) for the unused interpolation points are parameterized in the same way as the last interpolation point.

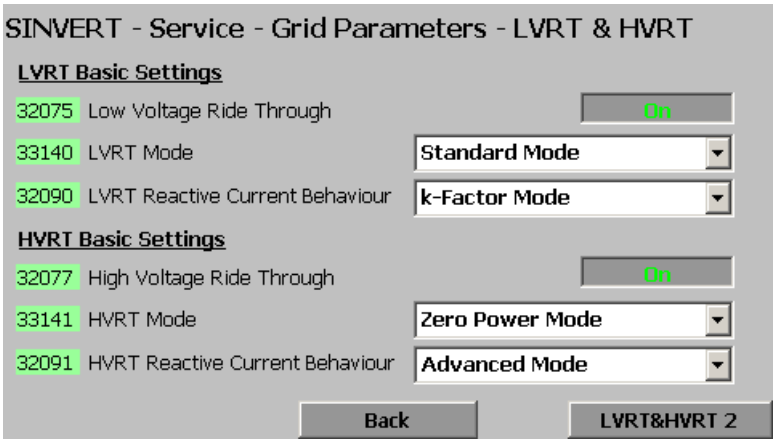


Figure 4-34 LVRT & HVRT [1/5]

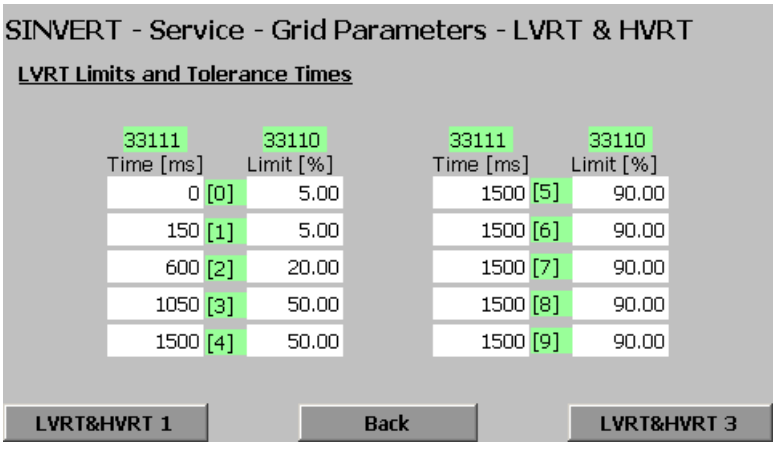


Figure 4-35 LVRT & HVRT [2/5]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
32075	LVRT activation	On Off	-
33140	LVRT mode	• Standard mode • Zero power mode • Q mode	-
32090	LVRT reactive power response	• k factor mode • Advanced mode	-
33111	Time t	0 ... 60000 ms	1 ms
33110	Voltage level U / U_C	0 ... 100 %	0.01 %

Example: Set time 200 ms and set voltage level of 5 % ⇒ If the voltage is continuously less than 5% U_{rated} for longer than 200 ms, the inverter switches off.

4.3.3 Reactive current provision in the event of voltage dips

Function

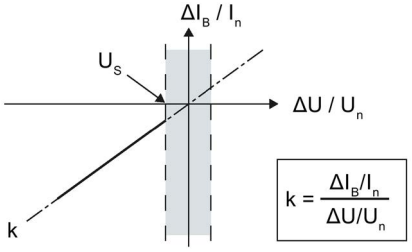
In the event of a voltage dip, the SINVERT PVS inverter can provide reactive current for voltage stability.

The level of the reactive current $\Delta I_B / I_n$ additionally fed in when a fault occurs results from the depth of the grid voltage dip $\Delta U / U_n$ and the k factor. No more than the rated current I_n can be fed in. During the voltage dip, as much active power as possible continues to be fed in.

In addition, the SINVERT PVS inverter has "Zero power mode". If this mode is set, the SINVERT PVS inverter remains on the grid for the parameterized time but feeds neither active nor reactive power into the grid.

"Q mode" is another mode. If this mode is set, the SINVERT PVS inverter remains on the grid for the parameterized time and feeds pure reactive power into the grid.

In "Standard mode" as well as "Q mode", the reactive current response can be be set not only via the k factor, but also via "Advanced mode". In this mode, it is possible to parameterize a Q=f(U) characteristic freely for LVRT.



U_n Rated voltage
U_0 Voltage before the fault
U_S Entry voltage of LVRT
U Instantaneous voltage (during the fault)
I_n Rated current
I_{B0} Reactive current before the fault
I_B Reactive current
ΔU = $U-U_0$
ΔI_B = I_B-I_{B0}

Figure 4-36 Reactive current curve

Settings

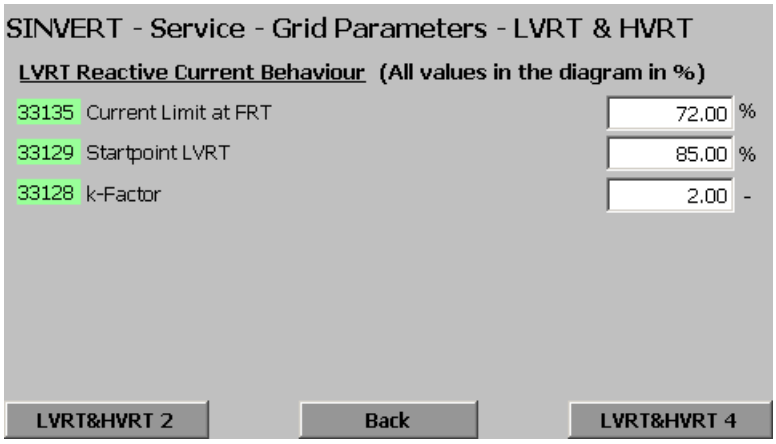


Figure 4-37 LVRT & HVRT [3/5]

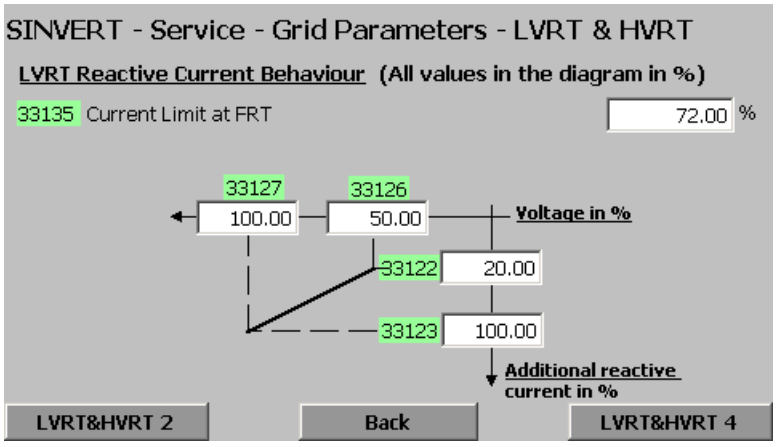


Figure 4-38 LVRT & HVRT [3/5]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
33135	Current limit for FRT	0 ... 100 %	0.01 %
33129	Entry voltage of LVRT U_S	0 ... 100 % of the rated voltage Example: A voltage dip of around 10% means 90% remaining grid voltage related to the rated voltage. Continuous operation takes place before this value. LVRT takes over if this value is exceeded.	0.01 %
33128	k factor*	0.0 ... 6.0	0.1

* Can only be set if zero power mode is deactivated

4.3.4 Behavior in the case of voltage rises (low voltage ride through)

Due to the growing spread of renewable energy forms, you must ensure that the inverter does not shut down immediately when brief voltage rises occur. The SINVERT PVS inverter has the ability to withstand brief voltage rises and remain on the grid. The shutdown behavior in the case of voltage rises can be set via the HVRT curve, see the chapter "Shutdown behavior in the event of voltage rises (Page 69)".

The SINVERT PVS inverter can continue to provide reactive current for voltage reduction during these voltage rises. The level of the reactive current can be set via the k factor depending on the extent of the grid voltage rise, see the chapter "Reactive current provision in the event of voltage rises (Page 72)".

4.3.5 Shutdown behavior in the event of voltage rises

Function

The HVRT curve can be parameterized by means of up to 10 interpolation points. An interpolation point consists of a voltage level U / U_n and a time t during which the voltage level can be present before the SINVERT PVS inverter shuts down. Linear interpolation is carried out between the two interpolation points. The voltage level is calculated from the ratio of the actual voltage U to the rated voltage U_n.

Note

The function can be deactivated if required.

The limit curve shown in the figure represents a typical HVRT curve as defined by many grid operators.

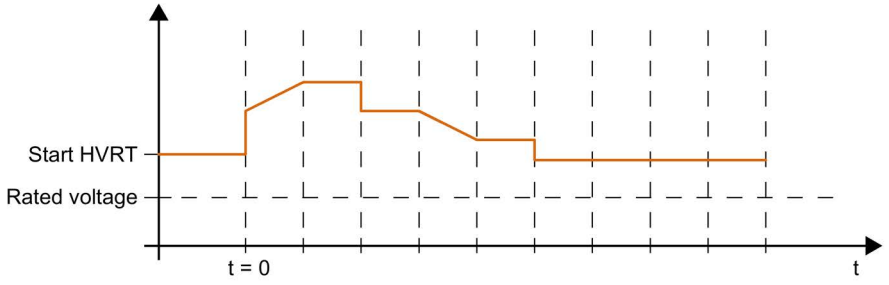


Figure 4-39 HVRT curve

Settings

Note the following points when parameterizing the HVRT curve:

- The parameterized HVRT curve must correspond to the undervoltage protection settings. For this reason, parameterize two of the interpolation points identically to the entered limit values of the overvoltage monitor.

  See Chapter Voltage monitoring (Page 76).

- When parameterizing, all fields must be filled, but it is not absolutely necessary to use all available interpolation points.

  When using fewer than 10 interpolation points, the order of the entered interpolation is decisive since interpolation between the individual points is linear. For this reason, always enter the used interpolation points first. Then enter the values of the last interpolation point in the subsequent fields for the interpolation points that are not required.

  You will find an example in the figure below. The first four interpolation points (0 to 5) are used. All the subsequent fields (6 to 9) for the unused interpolation points are parameterized in the same way as the last interpolation point.

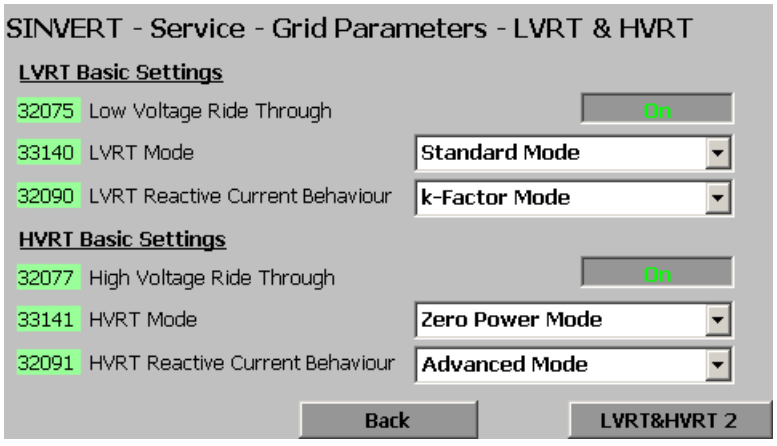


Figure 4-40 LVRT & HVRT [1/5]

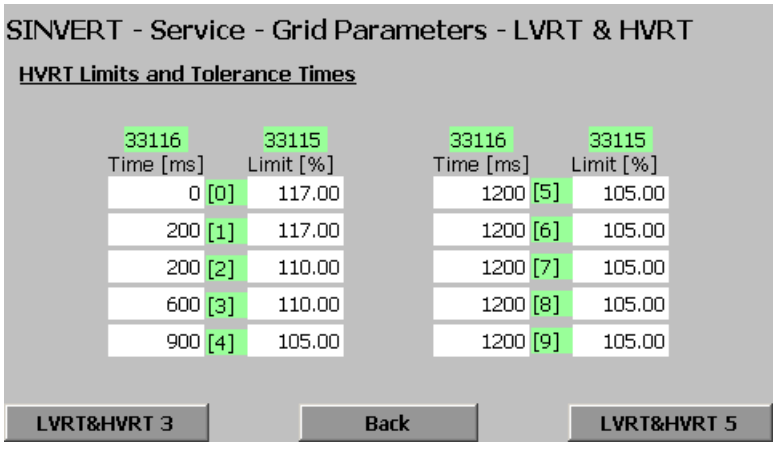


Figure 4-41 LVRT & HVRT [4/5]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
32077	HVRT activation	On Off	-
33141	HVRT mode	• Standard mode • Zero power mode • Q mode	-
32091	HVRT reactive power response	• k factor mode • Advanced mode	-
33116	Time t	0 ... 60000 ms	1 ms
33115	Voltage level U / U_C	100 ... 200 %	0.01 %

Example: Set time 200 ms and set voltage level of 117 % ⇒ If the voltage is continuously less than 117 % U_{rated} for longer than 200 ms, the inverter switches off.

4.3.6 Reactive current provision in the event of voltage rises

Function

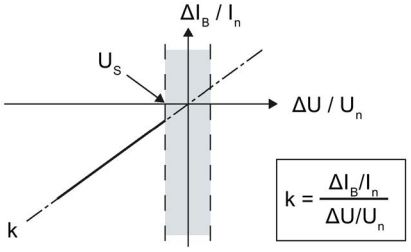
In the event of a voltage rise, the SINVERT PVS inverter can provide reactive current for voltage reduction.

The level of the reactive current $\Delta I_B / I_n$ additionally fed in when a fault occurs results from the extent of the grid voltage rise $\Delta U / U_n$ and the k factor. No more than the rated current I_n can be fed in. During the voltage rise, as much active power as possible continues to be fed in.

In addition, the SINVERT PVS inverter has "Zero power mode". If this mode is set, the SINVERT PVS inverter remains on the grid for the parameterized time but feeds neither active nor reactive power into the grid.

"Q mode" is another mode. If this mode is set, the SINVERT PVS inverter remains on the grid for the parameterized time and feeds pure reactive power into the grid.

In "Standard mode" as well as "Q mode", the reactive current response can be be set not only via the k factor, but also via "Advanced mode". In this mode, it is possible to parameterize a Q=f(U) characteristic freely for HVRT.



U_n Rated voltage
U_0 Voltage before the fault
U_S Entry voltage of LVRT
U Instantaneous voltage (during the fault)
I_n Rated current
I_{B0} Reactive current before the fault
I_B Reactive current
ΔU = $U-U_0$
ΔI_B = I_B-I_{B0}

Figure 4-42 Reactive current curve

Settings

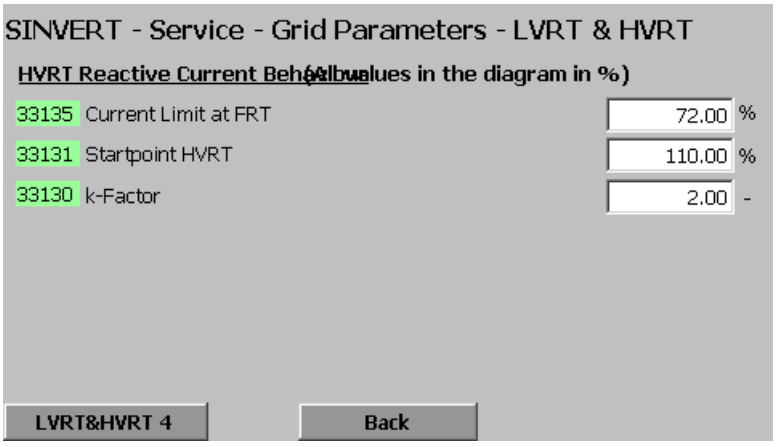


Figure 4-43 LVRT & HVRT [5/5]

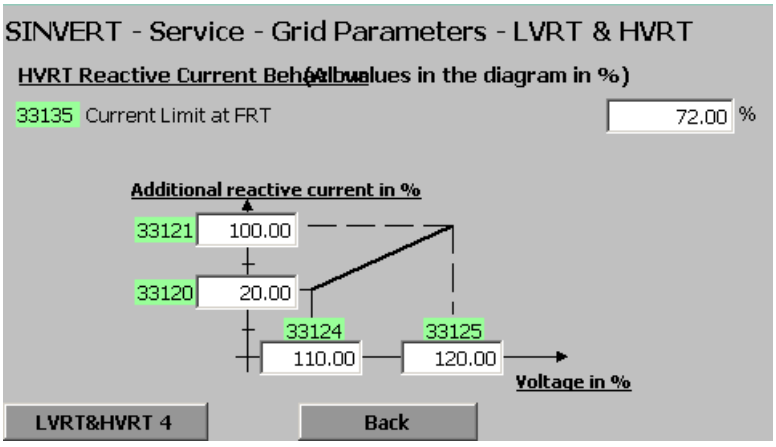


Figure 4-44 LVRT & HVRT [5/5]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
33135	Current limit for FRT	0 ... 100 %	0.01 %
33131	Entry voltage of HVRT U_S	100 ... 200 % of the rated voltage Example: A voltage dip of around 10% means 110% remaining grid voltage related to the rated voltage. Continuous operation takes place before this value. HVRT takes over if this value is exceeded.	0.01 %
33130	k factor*	0.0 ... 6.0	0.1

* Can only be set if zero power mode is deactivated

4.4 Decoupling protection

4.4.1 Grid monitoring

Function

The SINVERT PVS inverter monitors the public energy grid for violations of adjustable grid frequency and grid voltage limits. If the limits are violated for an adjustable time, the inverter disconnects from the grid.

4.4.2 Frequency monitoring

Function

The SINVERT PVS inverter monitors the grid frequency during operation. If a certain frequency range is exceeded or undershot, a grid fault can be assumed, and shutdown of the SINVERT PVS inverter is necessary. Up to six parameterizable limits for both overfrequency and underfrequency are available for shutdown outside the permissible frequency range.

A frequency and a tripping delay time can be parameterized for each limit.

If the grid frequency is outside the parameterizable range, the SINVERT PVS inverter shuts down, and a fault message is output.

As soon as the grid frequency returns to the permissible range, the fault message is automatically acknowledged.

If the grid is within the specified limits for restarting, see the chapter "Feed-in conditions (Page 79)", the inverter powers up again automatically.

Settings

On the "Frequency monitoring" pages, you set the upper and lower limit values (in %) for the grid frequency, as well as the associated delay (in ms).

The delay is the minimum time for which a fault must be active to effect shutdown. If the set limit values are undershot or exceeded for the set time, the inverter switches off with an appropriate fault message. Shutdown of the inverter takes approx. 80 ms.

The required limit values for overfrequency/underfrequency refer to the rated grid frequency of the inverter.

When parameterizing, all fields must be filled, but it is not absolutely necessary to use all available interpolation points.
When using fewer than the two available interpolation points, the sequential order of the entered interpolation points is decisive. For this reason, always enter the used interpolation points first. Then enter the values of the last used interpolation point in the subsequent fields for the interpolation points that are not required.

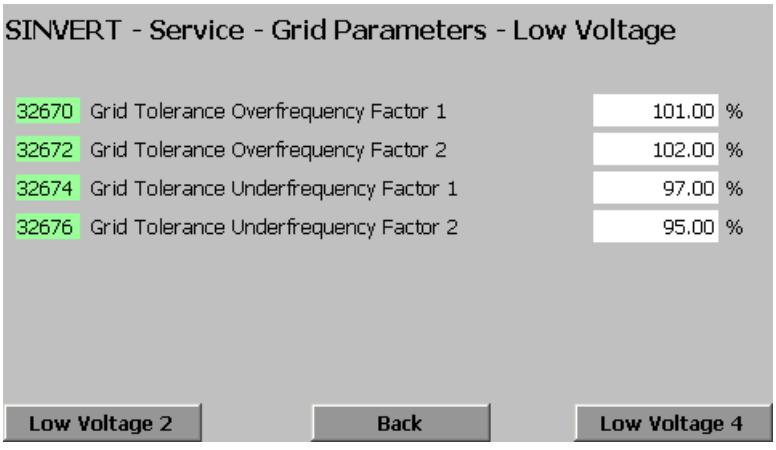

SINVERT - Service - Grid Parameters - Low Voltage
32670 Grid Tolerance Overfrequency Factor 1 101.00 %
32672 Grid Tolerance Overfrequency Factor 2 102.00 %
32674 Grid Tolerance Underfrequency Factor 1 97.00 %
32676 Grid Tolerance Underfrequency Factor 2 95.00 %
Low Voltage 2
Back
Low Voltage 4

Figure 4-45 Low voltage [3/5]

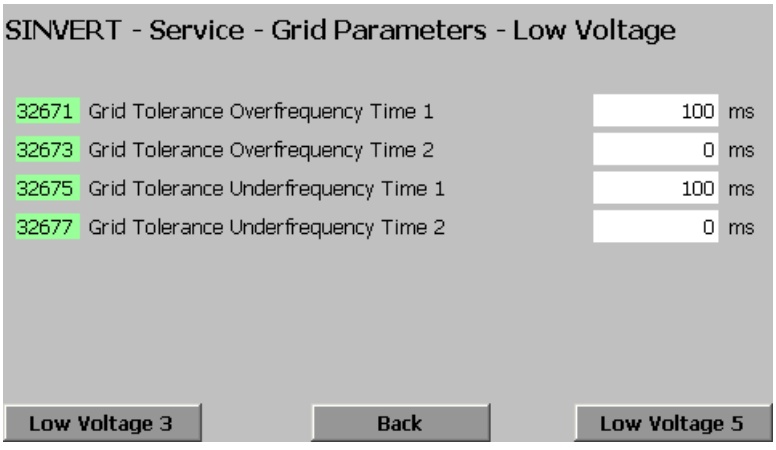

SINVERT - Service - Grid Parameters - Low Voltage
32671 Grid Tolerance Overfrequency Time 1 100 ms
32673 Grid Tolerance Overfrequency Time 2 0 ms
32675 Grid Tolerance Underfrequency Time 1 100 ms
32677 Grid Tolerance Underfrequency Time 2 0 ms
Low Voltage 3
Back
Low Voltage 5

Figure 4-46 Low voltage [4/5]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
32670	Overfrequency monitoring f_H 1	100 ... 150 % of the rated frequency (50 / 60 Hz)	0.1 %
32672	Overfrequency monitoring f_H 2	100 ... 150 % of the rated frequency (50 / 60 Hz)	0.1 %
32674	Underfrequency monitoring f_H 1	10 ... 100 % of the rated frequency (50 / 60 Hz)	0.1 %
32676	Underfrequency monitoring f_H 2	10 ... 100 % of the rated frequency (50 / 60 Hz)	0.1 %
32671	Tripping delay time tf for overfrequency monitoring f_H 1	0 ... 600000 ms	1 ms
32673	Tripping delay time tf for overfrequency monitoring f_H 2	0 ... 600000 ms	1 ms
32675	Tripping delay time tf for underfrequency monitoring f_H 1	0 ... 600000 ms	1 ms
32677	Tripping delay time tf for underfrequency monitoring f_H 2	0 ... 600000 ms	1 ms

4.4.3 Voltage monitoring

Function

The SINVERT PVS inverter monitors the grid voltage during operation. If a certain voltage range is exceeded or undershot, a grid fault can be assumed, and shutdown of the SINVERT PVS inverter is necessary. Up to two parameterizable limits are available for shutdown outside the permissible voltage range, both for overvoltage and undervoltage.

You can parameterize a voltage and a tripping delay time for each limit.

If the grid voltage is outside the parameterizable range, the SINVERT PVS inverter shuts down, and a fault message is output.

As soon as the grid voltage returns to the permissible range, the fault message is automatically acknowledged.

If the grid is within the specified limits for restarting, see the chapter "Feed-in conditions (Page 79)", the inverter powers up again automatically.

Settings

On the "Overvoltage monitoring" and "Undervoltage monitoring" pages, you set the upper and lower limit values (in %) for the voltage, as well as the associated delay (in ms).

The delay is the minimum time for which a fault must be active to effect shutdown. If the set limit values are undershot or exceeded for the set time, the inverter switches off with an appropriate fault message. Shutdown of the inverter takes approx. 80 ms.

The required limits refer to the AC rated voltage of the inverter.

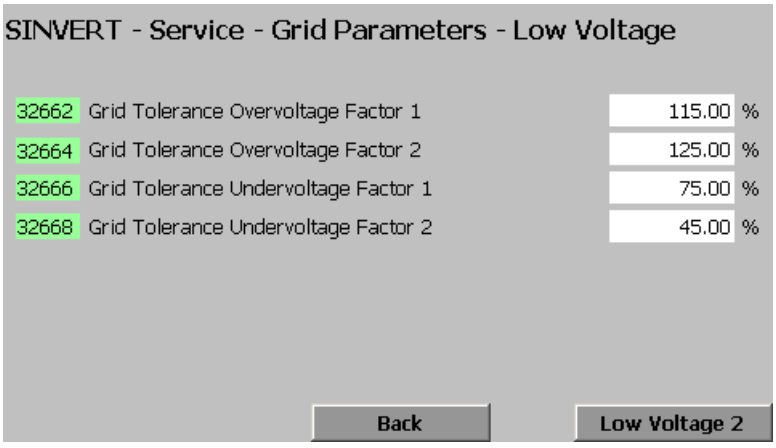

SINVERT - Service - Grid Parameters - Low Voltage
32662 Grid Tolerance Overvoltage Factor 1
115.00 %
32664 Grid Tolerance Overvoltage Factor 2
125.00 %
32666 Grid Tolerance Undervoltage Factor 1
75.00 %
32668 Grid Tolerance Undervoltage Factor 2
45.00 %
Back
Low Voltage 2

Figure 4-47 Low voltage [1/5]

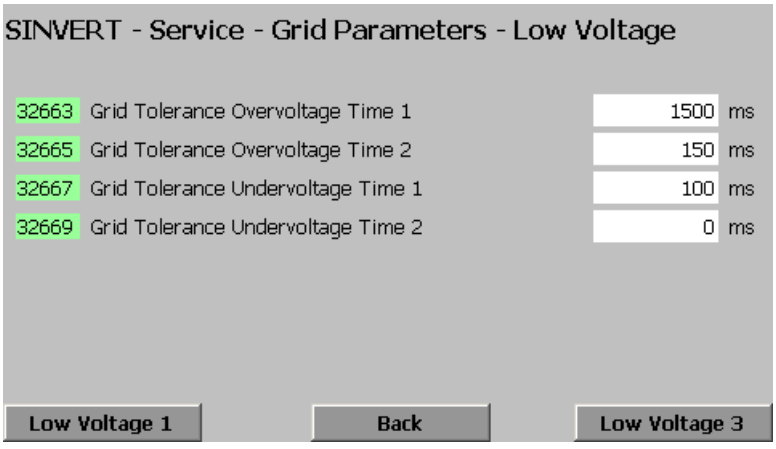

SINVERT - Service - Grid Parameters - Low Voltage
32663 Grid Tolerance Overvoltage Time 1
1500 ms
32665 Grid Tolerance Overvoltage Time 2
150 ms
32667 Grid Tolerance Undervoltage Time 1
100 ms
32669 Grid Tolerance Undervoltage Time 2
0 ms
Low Voltage 1
Back
Low Voltage 3

Figure 4-48 Low voltage [2/5]

Note

The parameterized LVRT curve must correspond to the undervoltage protection settings. For this reason, parameterize two interpolation points of the LVRT curve identically to the entered limit values of the undervoltage monitor.

See Chapter Shutdown behavior in the event of voltage dips (Page 64).

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
32662	Overvoltage monitoriong 1	100 ... 150 % of the rated voltage	0.1 %
32664	Overvoltage monitoriong 2	100 ... 150 % of the rated voltage	0.1 %
32666	Undervoltage monitoring 1	0 ... 100 % of the rated voltage	0.1 %
32668	Undervoltage monitoring 2	0 ... 100 % of the rated voltage	0.1 %
32663	Tripping delay time t_U for overvoltage monitoring 1	0 ... 600000 ms	1 ms
32335	Tripping delay time t_U for overvoltage monitoring 2	0 ... 600000 ms	1 ms
32667	Tripping delay time t_U for undervoltage monitoring 1	0 ... 600000 ms	1 ms
32669	Tripping delay time t_U for undervoltage monitoring 2	0 ... 600000 ms	1 ms

4.4.4 Feed-in conditions

In the event of a grid fault, connection of the inverter must be prevented. For this purpose, the SINVERT PVS inverter monitors the grid with regard to frequency and voltage, and switches on if the grid is within a parameterizable range.

One limit each is available to you for parameterizing the permissible frequency and voltage range. If the grid is within the parameterized limits, and if all restart conditions have been met, the inverter powers up again automatically.

The voltage limits are input as a percentage of the rated voltage; the frequency limits are input as a percentage of the rated frequency (50 / 60 Hz).

Note

The connection conditions range must be smaller than the shutdown conditions range to avoid the constant on and off switching of the inverter when operating in limit ranges of the permissible rated voltage/frequency.

You will find further information on the shutdown conditions in the chapters "Frequency monitoring (Page 74)" and "Voltage monitoring (Page 76)".

Settings

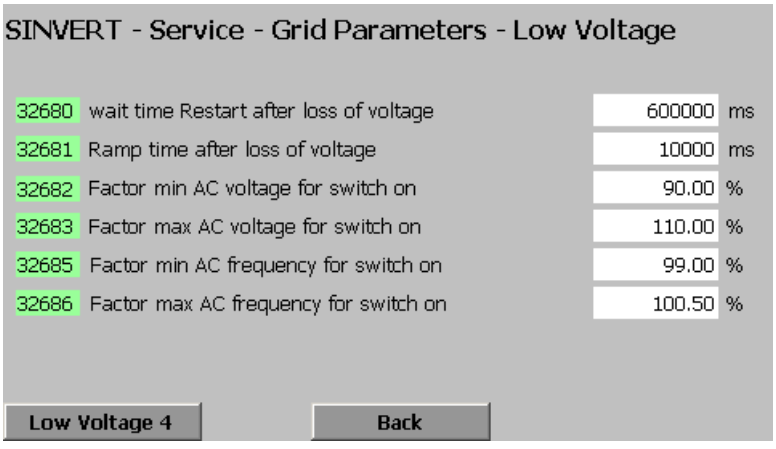

SINVERT - Service - Grid Parameters - Low Voltage
32680 wait time Restart after loss of voltage 600000 ms
32681 Ramp time after loss of voltage 10000 ms
32682 Factor min AC voltage for switch on 90.00 %
32683 Factor max AC voltage for switch on 110.00 %
32685 Factor min AC frequency for switch on 99.00 %
32686 Factor max AC frequency for switch on 100.50 %
Low Voltage 4
Back

Figure 4-49 Low voltage [5/5]

The function can be set via the following parameters:

Parameter number	Parameters	Range	Increment
32682	Undervoltage limit	80 ... 100 % of the rated voltage	0.01 %
32683	Overvoltage limit	100 ... 115 % of the rated voltage	0.01 %
32685	Underfrequency limit	90 ... 100 % of the rated frequency (50 / 60 Hz)	0.01 %
32686	Overfrequency limit	100 ... 103 % of the rated frequency (50 / 60 Hz)	0,01 %

Application planning

5

The following chapter contains detailed information about packaging, dispatch, delivery, storage, transport, installation location and configuring. Always read and follow the instructions given in this documentation. Observe the relevant safety notices at all times. Make sure that the conditions specified for storage, transport and installation location are fulfilled.

5.1 Packaging, dispatch and delivery

Further information about the transport packaging used, dispatch of the inverter by Siemens and the measures to be taken following delivery of the unit is given below.

5.1.1 Transport packaging

Envelope

The inverter cabinet sections are packaged in a loose-fitting plastic envelope which must not be tightly stuck or tied to the cabinets at the bottom.

Transport pallet

The inverter cabinet sections are mechanically coupled with the pallet:

- on the one hand with strapping around the pallet and inverter
- and on the other by bolting the cabinet on the pallet using a bracket

Design

The basic design of the transport pallet is shown in the figure below.
This is a customized version of the pallet.

- This is made necessary on the one hand by the dimensions of the cabinet sections
- and on the other hand, this design offers sufficient mechanical stability for safe lifting by a crane.

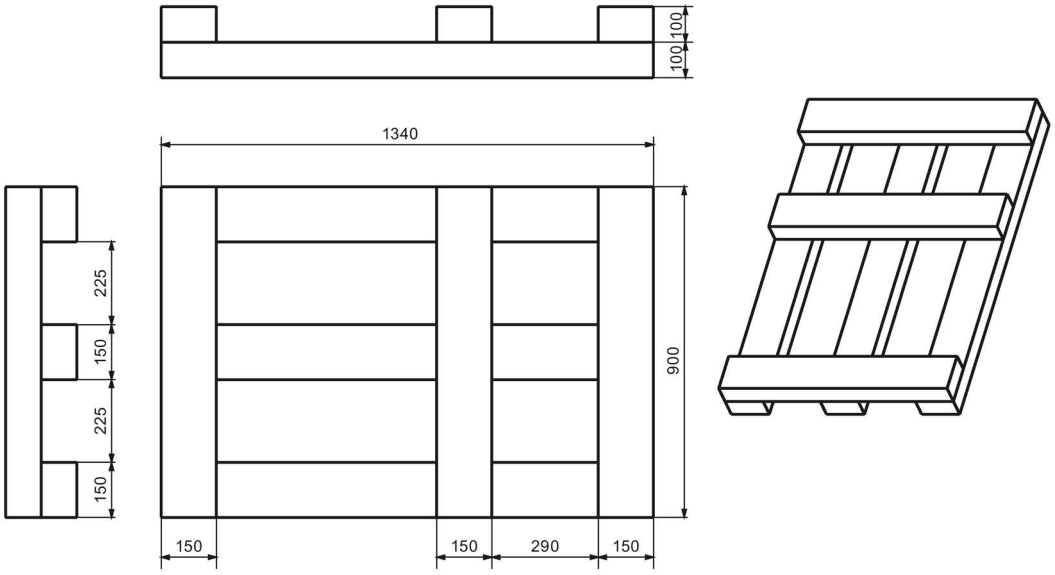


Figure 5-1 Dimensions of the transport pallet

5.1.2 Center of gravity marking and transport position

Center of gravity marking

The weight mass of the cabinet sections is distributed eccentrically and asymmetrically on both the front and side faces. The weight distribution is indicated directly on each cabinet section of the inverter by the center of gravity marking in accordance with ISO 780/Symbol 7.

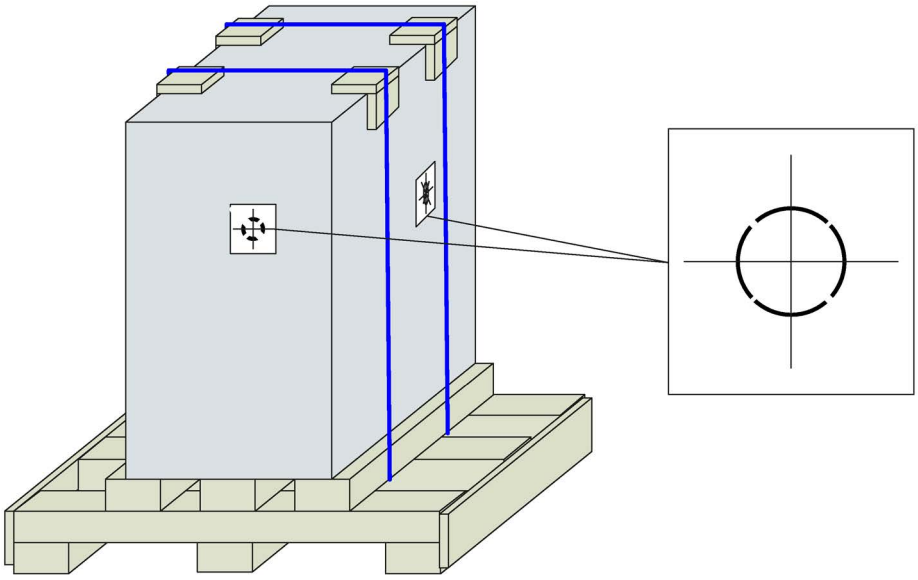


Figure 5-2 Center of gravity marking on inverter

Transport position

The inverter must never be tipped.
Always observe the specified **vertical** transport position.

5.1.3 Dispatch and delivery

The inverter is delivered in two transport units. Each cabinet section is transported on a special pallet. The transport units are checked by Siemens prior to dispatch to ensure that they are correctly packaged and free of damage.

5.1.4 Checking the consignment

Please check that the consignment is complete against the accompanying dispatch documentation. If any items are missing from the consignment, please notify the relevant contact person immediately.

5.1.5 Scope of supply

The scope of supply of the SINVERT PVS inverter includes the following:

- Inverter AC cabinet mounted on transport pallet
- Inverter DC cabinet mounted on transport pallet
- Accessories pack (on Euro pallet):
  - 1 x cable 4 m fitted with lugs at both ends, on pallet
  - 1 x mounting kit for screwing the cabinet sections in black crate
  - Hexagonal screw M12x50, strain washer, hexagonal nut
- Operating instructions (compact) as hard copy

5.2 Transport

The methods described below are the only permitted methods for transporting the SINVERT PVS. No other method of transport is permitted. Siemens shall not accept liability for any personal injuries or property damage resulting from the transportation of the product by an improper method.

In addition to the safety notices applicable to specific transport methods, the general safety instructions must also be noted and followed.

5.2.1 General safety instructions for transporting

The general safety instructions must always be followed regardless of the method of transport. These mainly refer to the mechanical connection between the pallet and the inverter cabinet section, to the mechanical connection between individual inverters, and to the risk of tipping.

Mechanical connection between pallet and inverter cabinet section

- Never transport the pallet with the inverter cabinet section without a secure mechanical connection between the pallet and inverter. See the figure below.
- The mechanical connection comprises strapping and bolting of cabinet base to the pallet.
- Before the package is moved, the bolting and strapping must be checked to ensure they are secure.
- Please also note the safety notice regarding the risk of tipping if the pallet and cabinet are not mechanically connected.

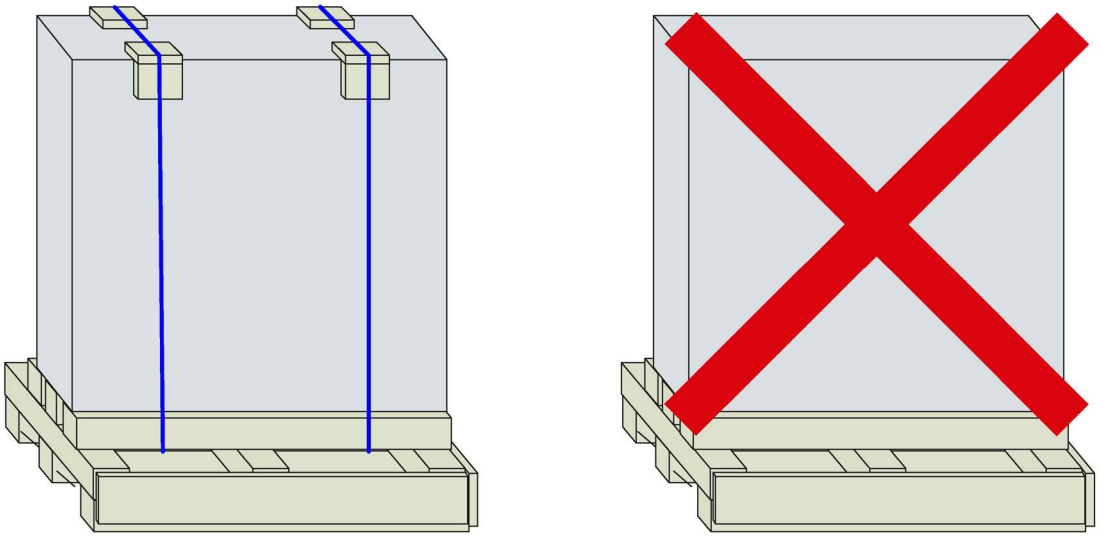


Figure 5-3 Transport packaging – Mechanical connection with the transport pallet

⚠ WARNING

Danger to life through tipping due to lack of mechanical connection with the pallet

The cabinet may be transported only if it is securely mechanically coupled with the pallet (strapping and bolting). If the load is not securely coupled, it can tip or fall off the pallet. In this case, the high weight mass of the cabinets can cause serious injuries, death and substantial property damage.

Danger of tipping of the transportation unit

WARNING

Danger to life from tipping!

A cabinet, whether with or without pallet, must never be tipped in any direction. The cabinet is very heavy. Tipping it too far and causing it to topple over can therefore result in serious injury, death and substantial property damage.

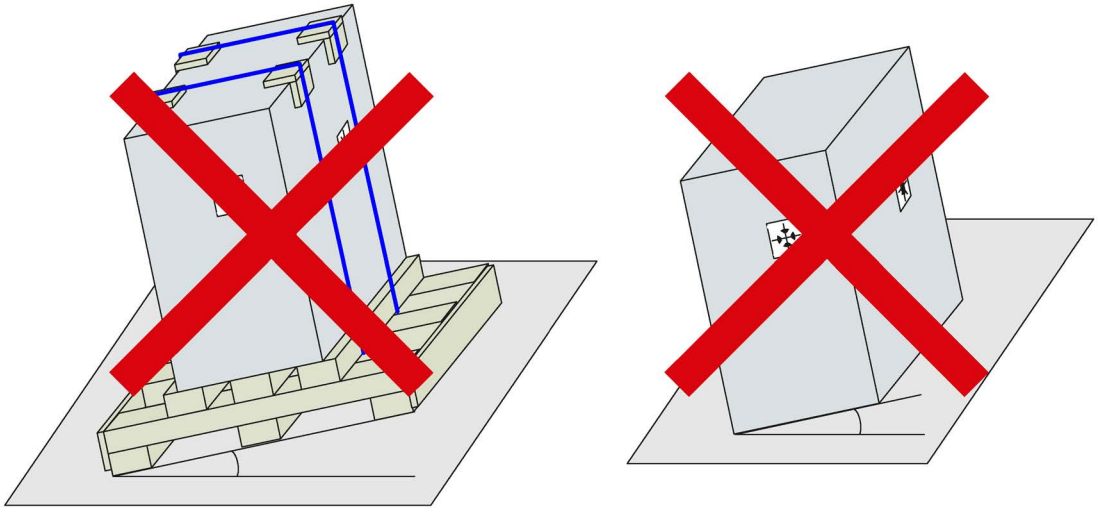


Figure 5-4 Impermissible tipping of cabinets and pallets

Mechanical connection between the inverters

The SINVERT inverter is transported in two consignment units or cabinet sections. No provision is made for transporting connected cabinet sections.

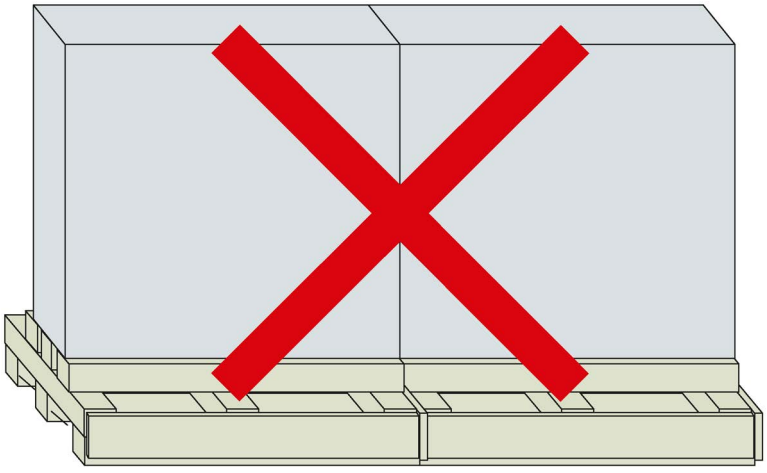


Figure 5-5 Impermissible transport of two cabinet sections

The inverter cabinet sections must never be transported once they have been assembled into a single unit.

⚠ WARNING

Danger to life from transport of assembled cabinet sections!

Owing to their design, cabinet sections must never be transported once they have been mechanically assembled into a single unit. Cabinet sections must always be transported as a single unit by one of the permitted methods of transport. The heavy weight of the cabinets means that they can cause serious injury, death and substantial property damage if incorrectly handled.

Locking of the doors

The doors on the cabinet sections are closed by Siemens prior to dispatch. Keep these doors closed and locked at all times during transportation.

The door locks are secured against accidental unlocking by means of small plastic caps. The plastic caps must be removed when the consignment is positioned at the final installation location.

⚠ CAUTION

Serious injury in the case of transporting with opened doors!

Open doors can hit people or other objects while a unit is being transported. They can cause serious injury or property damage.
Keep the doors locked.

5.2.2 Transporting using pallet truck and fork-lift truck

The operator of the pallet truck must always ensure that the equipment required to move the load is in good working order and that high standards of operational safety are fulfilled. Loads must always be transported in compliance with all relevant health and safety regulations as well as the instructions in this documentation.

Always use a pallet truck or a fork-lift truck which is approved to carry the weight of the relevant cabinet section.

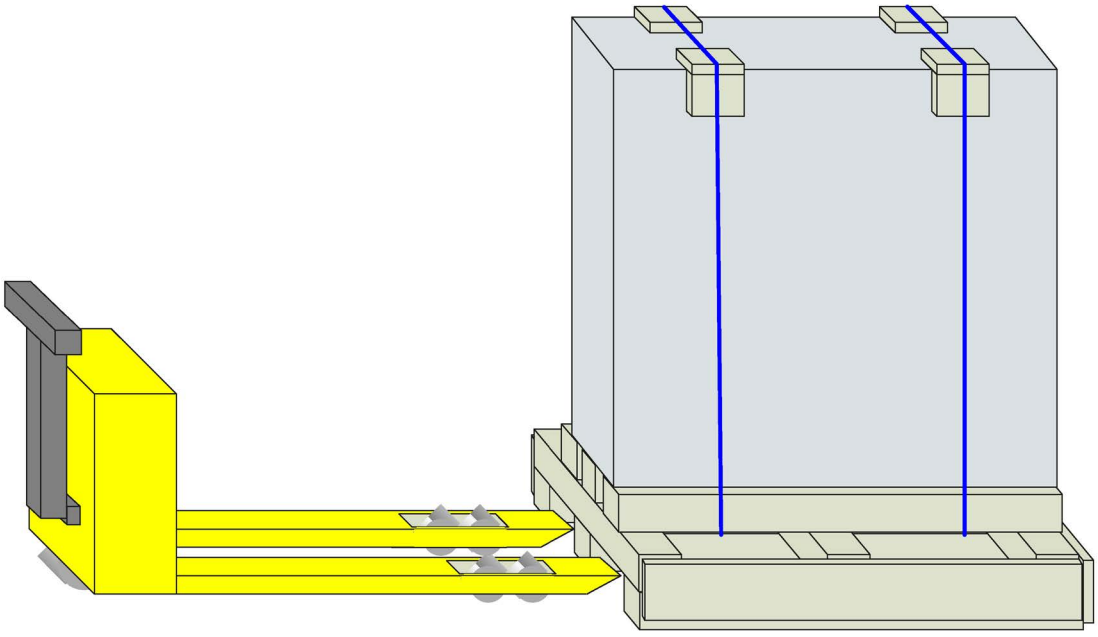


Figure 5-6 Example of transport using a pallet truck

Owing to the high and eccentric center of gravity of the cabinet sections, there is a risk that they will topple over if incorrectly handled.

⚠ WARNING

Danger to life from tipping!

The heavy weight of the cabinets means that they can cause serious injury, death and substantial property damage if they tip.

A cabinet, whether with or without pallet, must never be tipped.

5.2.3 Transporting by crane

5.2.3.1 General notices

The crane driver must always ensure that the crane and the equipment required to move the load are in good working order and that high standards of operational safety are fulfilled. Loads must always be transported in compliance with all relevant health and safety regulations as well as the instructions in this documentation.

⚠ WARNING

Danger to life through inappropriate transportation equipment!

The equipment used must be designed to carry the load to be transported. It must be in good working order and correspond to one of the approved methods specified in this manual. When equipment of a type not approved is used to transport loads, they can drop or topple over, causing serious injury, death or substantial property damage.

Ensure compliance with all safety requirements for the transportation of suspended loads:

⚠ WARNING

Danger to life from suspended load!

Never stand under a suspended load. There is a risk of serious injury, death or substantial property damage if the load drops off the crane.

Always take into account the high center of gravity and asymmetric load distribution as well as the instructions relating to attachment of the load.

⚠ WARNING

Danger to life from asymmetric load distribution!

It is essential to note the center of gravity marking and the asymmetric load distribution when attaching the load. There is a risk of serious injury, death or substantial property damage if the load drops off the crane.

5.2.3.2 Permissible transport methods

There are basically two permissible methods of transporting the cabinets by crane:

- Transport with H beam
- Transport with frame structure

The cabinets are not designed to be transported by any other method and other methods are not therefore permitted. If you choose a method of crane transport which is not expressly approved in this document, Siemens will not accept liability for the consequential damage.

Transport with H beam or frame structure

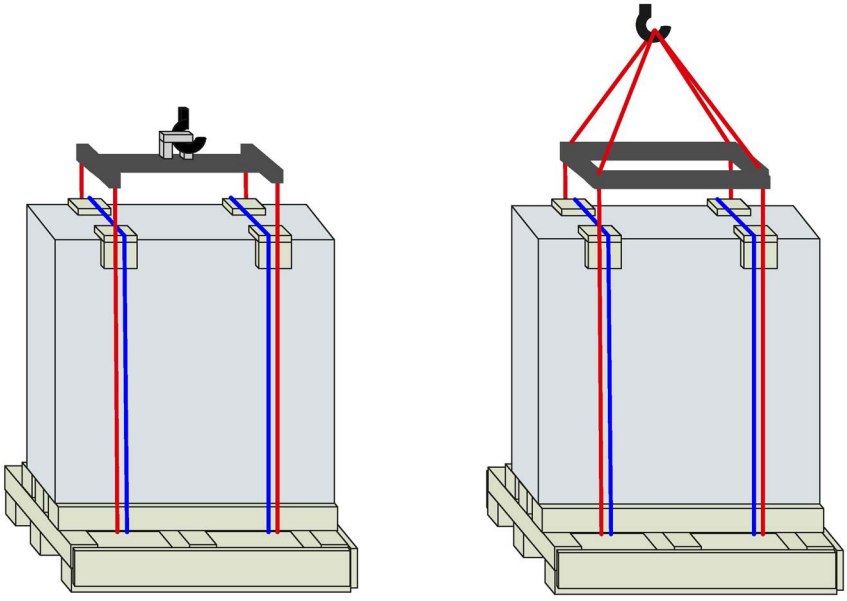


Figure 5-7 Crane transport with H beam and frame structure

Procedure

Whether a load is transported by crane on an H beam or a specially designed frame structure, it is always essential that the inverter is mechanically coupled to the pallet.

1. The crane ropes are placed under the load at a marked position in parallel to the side wall.
2. They are then brought up in parallel to and at an appropriate distance from the straps, from where they are threaded through a frame structure or attached to the H beam.

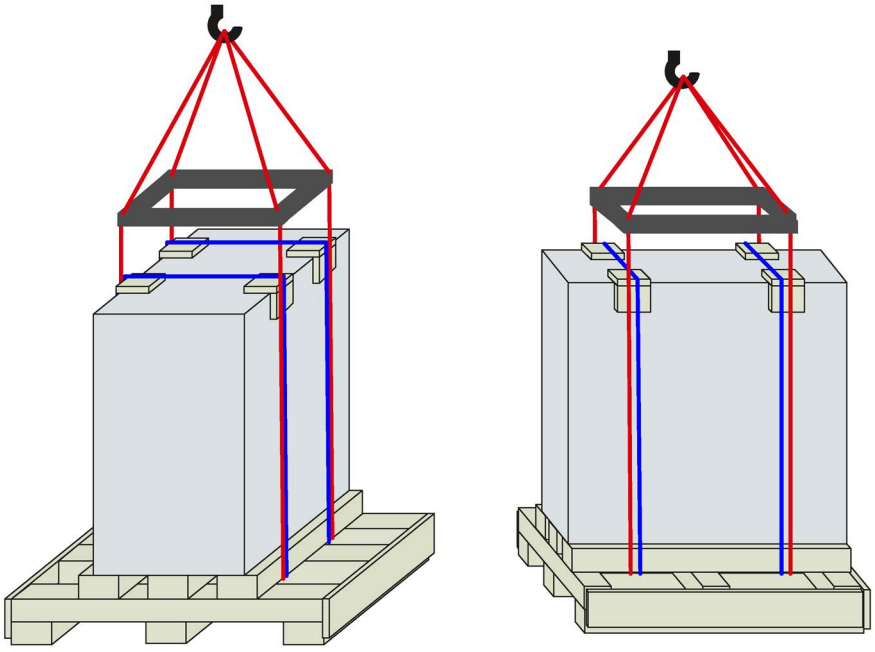


Figure 5-8 Strapping and roping for transport with frame structure

⚠ WARNING

Danger to life from asymmetric load distribution!

It is essential to note the center of gravity marking and the asymmetric load distribution when attaching the load. Otherwise there is the threat of tipping or dropping of the load, with the possibility of serious injury, death and substantial property damage.

5.2.3.3 Impermissible transport methods

Owing to the design of the cabinets, it is expressly prohibited to use the crane transport methods listed below:

- Use of crane eyelets
- Use of crane beams
- Prohibited attachment of ropes along vertical sides of load

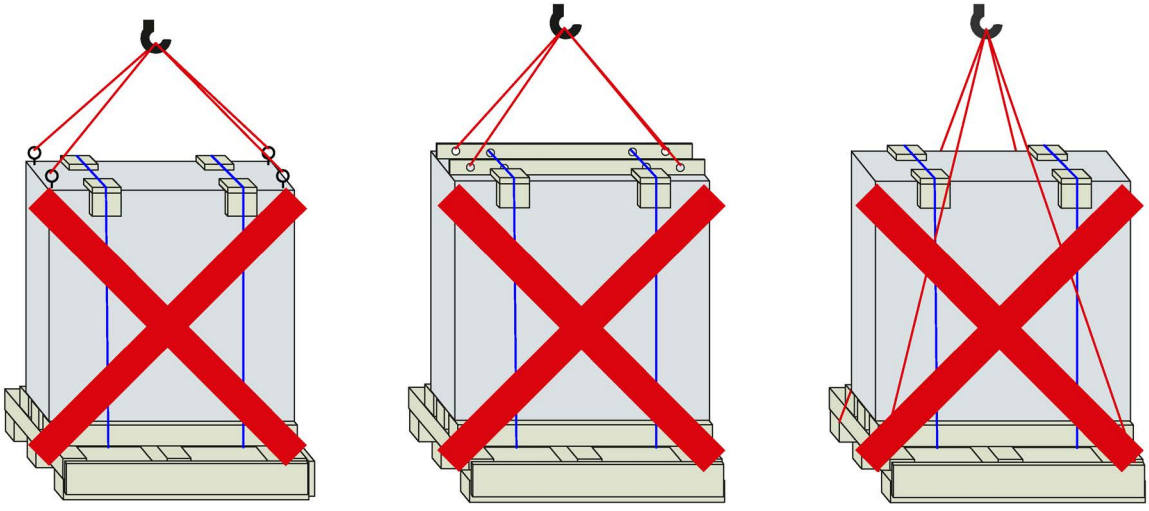


Figure 5-9 Impermissible transport methods: Crane eyelets, crane beams, roping along vertical sides

Please note that other methods apart from those mentioned above are also prohibited if they are not expressly approved by Siemens as a permissible method of transport.

⚠ WARNING

Danger to life from impermissible use of crane eyelets and steel lifting elements!

The inverter cabinets are not designed for transportation by crane on eyelets or steel lifting elements. It is absolutely prohibited to transport the inverters on crane eyelets or steel lifting elements. If excessive mechanical stress causes the load to fall off the crane, there is a risk of serious injury, death or substantial property damage.

⚠ WARNING

Danger to life from impermissible attachment of ropes along vertical sides of load!

The cabinets are not designed to be transported by crane from ropes attached along the vertical sides of the load. This method of transport is expressly prohibited. If excessive mechanical stress causes the load to fall off the crane or to tip, there is a risk of serious injury, death or substantial property damage.

5.2.4 Transport and alignment of cabinets in electrical operating areas

Removing the transport locks

The cabinets are attached to the pallet by means of transport locks (upward-facing screws).

1. To lift the cabinets off the pallet, you first need to undo the screw nuts.
2. To slide the cabinets off the pallet, you need to push the screws out downwards far enough (e.g. using a hammer and a thick nail), so that the surface of the pallet becomes smooth.

Moving the cabinet off the standard pallet

All cabinets can be moved on rollers placed under the cabinet frame. As rollers, you should use solid metal rods with a length of 20 cm and a diameter of 2 cm.

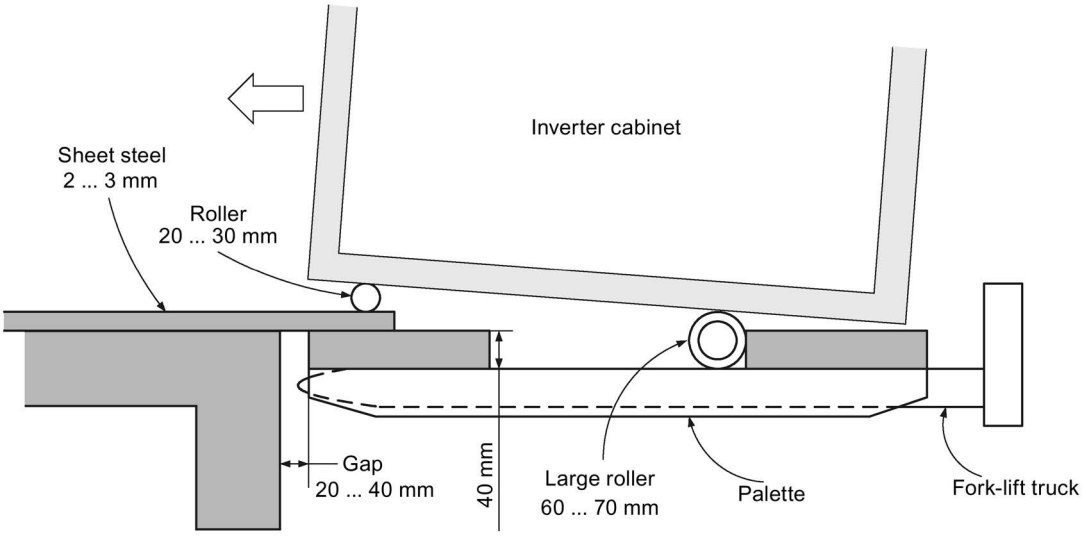


Figure 5-10 Moving the cabinet off the standard pallet

- Use a crowbar to lift the cabinet so that you can place the rollers under the frame. If you want to change the rolling direction, you must lift the cabinet again, turn the rollers by 90° and place them under the frame again.
- You may need to strengthen the floor with metal sheets before you move the cabinets over it. Make sure that the metal sheets are placed such that you will be able to remove them again once the inverters have been installed.
- In order to move or roll the cabinet off the pallet, you will need a solid metal bar or a strong pipe of 100 cm in length and 6 cm in diameter.

Procedure

1. Adjust the pallet so that it is level with the adjacent surface, e.g. floor of the equipment room.
2. Cover the gap between the pallet and floor with a metal sheet (5 to 10 cm) so that the rollers do not get caught in the gap.
3. Place a roller on the metal sheet and under the cabinet frame.
4. Place a thick roller under the cabinet at a position where there are no cross-planks in the pallet.
5. With the assistance of installation personnel, push the cabinet off the pallet.
6. As the cabinet moves forward, place more rollers underneath.

Note

Use thick-walled steel rods. Round steel bars, round wooden timbers or steel rollers enclosed in concrete are also suitable for the purpose.

The diameter of the rods must be at least 6 cm.
The rods must be at least 20% longer than the cabinet.

5.3 Storage

It is absolutely essential that the inverter units are stored in compliance with the storage conditions as described in Chapter Environmental conditions (Page 185). In the event of ingress of dirt, pollutants or liquid into the equipment, formation of condensation, damage or any other failures to comply with the prescribed storage conditions, the equipment must not be commissioned until the correct remedial procedure has been discussed with and approved by Siemens AG.

The devices must be stored such that they are protected against the ingress of sand or dust.

In the case of noncompliance with the above, Siemens will not accept liability for damage arising from unauthorized commissioning.

⚠ WARNING

Danger to life upon commissioning following impermissible storage!

Cabinets which have been stored in conditions that do not meet the prescribed standard must not be commissioned. Failure to comply with storage standards may result in electric shock, other serious injury or substantial property damage.

5.4 Site of installation

The site of installation must comply with certain requirements relating to environmental conditions, construction and layout of operating areas, connections to be provided, noise control, fire protection, EMC and ventilation. Detailed information about the requirements of the installation site can be found below.

5.4.1 General requirements

A room which is deemed suitable to house a SINVERT inverter must comply with certain general requirements in addition to the applicable environmental conditions. These are described in detail below.

Foundation

The inverter must be erected on a dry, level and non-combustible foundation. This foundation must be constructed such that it can withstand the static and dynamic stresses produced by the inverter.

Connections

The connections described below must be provided at the site of installation so that the SINVERT inverter can be installed easily and correctly.

Electromagnetic compatibility (EMC)

The inverter has been tested for electromagnetic compatibility in accordance with standards EN 61000-6-2 (interference immunity) and EN 61000-6-4 (interference emission). The SINVERT inverter is thus designed for use in industrial environments. It is not designed for use in residential environments. Siemens shall not accept liability for any consequential damage if the device is installed in a residential environment. In master/slave mode, a minimum distance of 20 m must be maintained to the boundary between the installation and the public domain for compliance with EMC Directive 2004 / 108 / EC. Alternatively, the system can be set up in metal containers with a damping effect of at least 10 dB.

Pollution degree

Suitable measures must be taken to ensure that degree of pollution 2 is not exceeded inside the inverter cabinets.

NOTICE
Malfunction due to pollution! To ensure long-term reliable operation of the equipment, suitable measures must be taken to prevent the ingress of dirt and dust.

5.4.2 Requirements of electrical operating areas

In addition to the environmental conditions for operation and the general requirements of sites of installation, electrical operating areas must also comply with further special requirements. The SINVERT inverter must be installed in a locked electrical operating area.

DIN VDE 0100-200 defines a locked electrical operating area as a "room or space which is used exclusively for the operation of electrical equipment and which is kept locked". The lock may be opened only by authorized persons. Access is restricted to persons with appropriate electrical qualification. Compliance with the requirements of DIN VDE 0100-731 (Erection of power installations with rated voltages below 1000 V – Electrical locations and locked electrical locations) is particularly important. A number of key requirements are listed in brief below. For a detailed description of all requirements, please refer to the standards DIN VDE 0100-200, DIN VDE 0100-729 and DIN VDE 0100-731. These requirements must be met in every case.

⚠ WARNING

Danger of life from unauthorized access to electrical operating areas!

If the requirements pertaining to locked electrical operating areas are not fulfilled, unauthorized persons might gain access to the inverter. Lack of knowledge in the safe handling of electrical installations by such persons could result in death, serious injury and substantial property damage.

Barriers and labeling

DIN VDE 0100-731 stipulates that electrical and locked electrical operating areas must be segregated from other areas by barriers of at least 1800 mm in height. Where the barriers are formed by grating, the maximum permissible mesh size is 40 mm. An adequate number of warning notices must be displayed at access points.

Walkways, doors, windows

Doors

The following requirements apply to the doors of locked electrical operating areas:

- Access only through lockable doors or covers
- Doors must open outwards
- Door locks must prevent access to unauthorized persons, but allow exit from the area

Windows

The following requirements apply to the windows of locked electrical operating areas:

- Windows must be locked to prevent persons from entering in cases where the locked electrical operating areas are not located in enclosed premises or on a secure site.

Escape route/walkways

The following requirements apply to the escape routes from and walkways to locked electrical operating areas:

- DIN VDE 0100-731 stipulates that an escape route must not exceed 40 m in length.
- DIN VDE 0100-729 prescribes that walkways with a length in excess of 20 m must be accessible from both ends.
  This is recommended for walkways with a length of more than 6 m.
- The doors open through 140°.
- The minimum clearance between the wall and inverter is 1000 mm.
- When inverters are installed front to front, it is expected that open doors will restrict space on one side only. Even with this arrangement, the clearance between the devices on the other side must be at least 1000 mm due to the door opening angle of 140°. Doors may be opened only on one side of the inverter line-up, but not on opposite sides at the same time.
- Compliance with the specified walkway widths and escape route lengths is essential.
- It may be necessary to comply with further requirements stipulated by local regulations.
- Please also take the following safety notice into consideration:

⚠ WARNING

Danger of life from excessively narrow walkways and excessively long escape routes!

Walkways which are too narrow or escape routes which are too long can hinder or prevent the escape of people in emergency situations. Death and serious injury can result.

5.4.3 Ventilation (air supply and extraction)

The following requirements must be fulfilled in order to ensure adequate ventilation of the inverter cabinets:

- The ambient temperatures must remain within the specified tolerance range
- The required quantity of air flow must be provided
- The heated exit air must be drawn away from the unit so that the maximum permissible ambient temperature is not exceeded
- It is essential to prevent thermal short circuits
- The supply air must comply with the technical specifications regarding air quality, contamination and moisture content, (see Chapter Environmental conditions (Page 185)).

Air enters the inverter via the vents in the doors and exits via the grille on top of the cabinet.

The use of exhaust-air shrouds is recommended when installing the inverter cabinets in a container (see Chapter Accessories (Page 208))

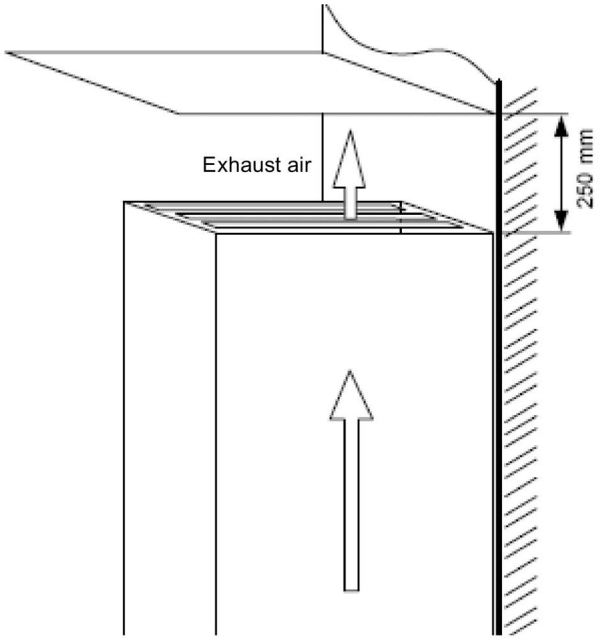


Figure 5-11 Ventilation - minimum clearance at top

5.4.4 Grounding and lightning protection

Lightning protection and grounding systems must be implemented in accordance with IEC62305.

5.5 Configuring information

Note the following points when configuring the PV plant.

Permissible DC currents

When dimensioning the PV plant, ensure that the DC currents do not exceed the permissible DC current in any state.

Specification of the medium-voltage transformer and additional overvoltage protection elements

Each subunit of the inverter must be connected to the medium-voltage transformer with galvanic isolation.

Information on the specification of the medium-voltage transformer can be found on the Internet (http://support.automation.siemens.com/WW/view/en/46183222/133300).

Installation

6

6.1 Preparation

This chapter contains instructions and tips on the correct installation of the SINVERT PVS 600Series. Always take note of the safety notices in the relevant chapters. Always comply with the relevant local rules and regulations which apply at the site of installation.

General Information

The devices must be installed and cooled in accordance with the guidelines in this document.
Protect the inverters against impermissible loads.

Requirements of the site of installation

The operating areas must be dry and free of dust. The air supplied must not contain any electrically conductive gas, vapors, or dust, which could impair operation.

Unpacking the cabinets

Make sure that the entire consignment is undamaged.

The packaging material must be disposed of in accordance with the applicable country-specific guidelines and rules.

Tools required

- Torque wrench 20 to 100 Nm
- Ratchet screwdriver with extension
- Socket wrench insert 18 mm, 13 mm, 17 mm
- Open jaw wrenches 18 mm, 13 mm, 17 mm
- Screwdriver slotted 1 mm, 2 mm, 3 mm
- Torx screwdriver T20

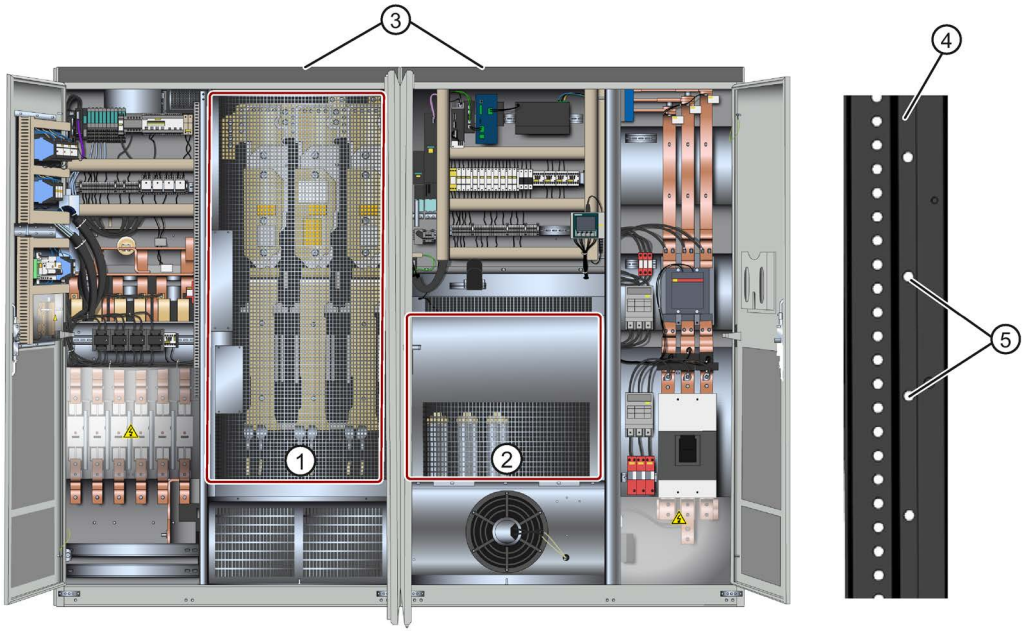
6.2 Safety information on bolting the cabinet sections together

NOTICE
Mechanical damage Stresses occurring during transport can exert mechanical pressure on the components. This can result in property damage. • Line the cabinets up precisely with each other in order to avoid shearing forces when the base units are bolted together. • Make sure that the foundation on which the inverter is to be installed is completely level and flat.

6.3 Bolting the cabinet sections together

Proceed as follows to bolt the cabinet sections together:

1. Remove the following covers:
   - The cover of the AC capacitors
   - The inverter covers
   - The protective grilles on the two cabinet sections
2. Place the cabinets together in such a way that the side panels with their fixing holes are coincident.
3. Bolt the two cabinets together at the accessible points on the front and top of the frame and tighten each screwed connection to a torque of 20 Nm.
   - Use the bolts and nuts from the accessories pack.



① Inverter cover
② Cover of the AC capacitors
③ Protective grilles
④ Frame, inner view
⑤ Fixing holes for bolting the cabinet sections together

Figure 6-1 Bolting the cabinet sections together

6.4 Mechanical connection to the foundation

There are holes in the frame of the cabinets which allow them to be bolted to the floor. Alternatively, when mounting the cabinets to steel beams it is possible for to the cabinets to be welded to the base.

When fixing the cabinets to the base, the procedure used and the type of attachment should be adapted to the conditions of each installation.

To be observed:

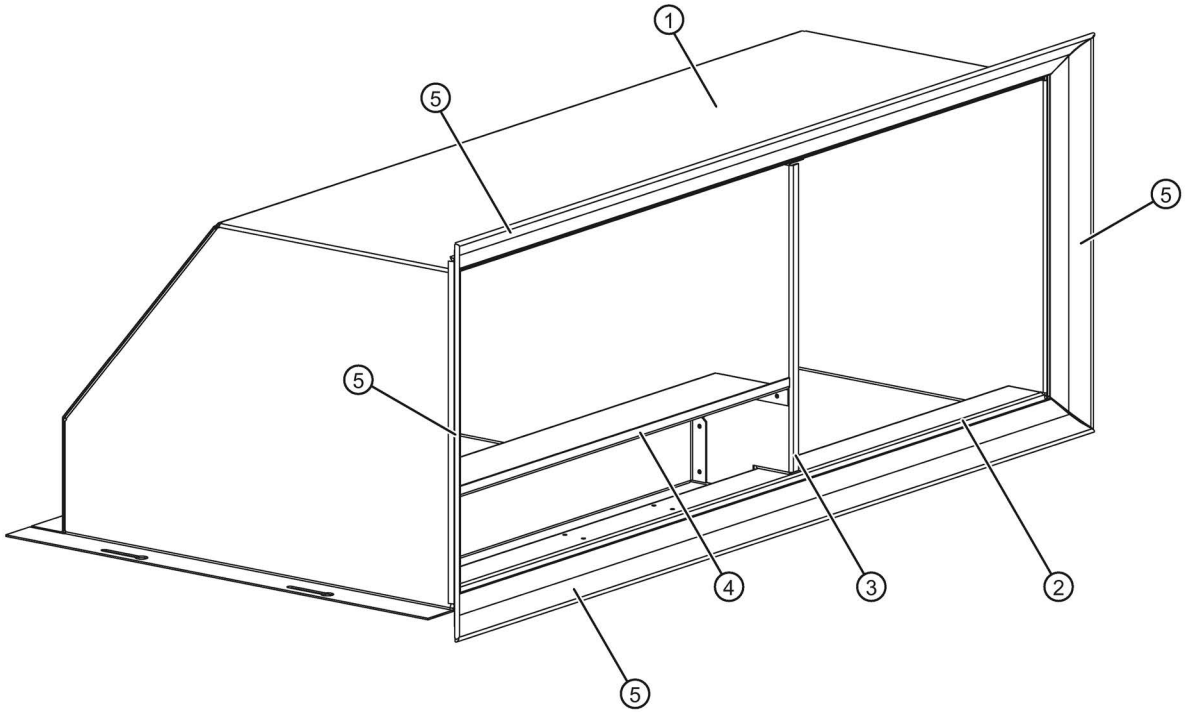
- For the **dimensions** of the base plate and positions of mounting holes for floor mounting, see the images in the chapter Base plate (Page 201).
- For access to mounting holes, it is advantageous to add only one cabinet at a time, and to screw it to the base before installing a second cabinet.
- The holes in the frame have a **diameter of 14 mm** and are suitable for M12 bolts.

6.5 Installing the exhaust-air shrouds (optional)

The exhaust-air shrouds are available as accessories. For details, see Section Accessories (Page 208).

The exhaust-air shrouds for the AC cabinet and the DC cabinet of the inverter differ only in their air deflectors. The basic shroud, partition, and cross struts are identical on both exhaust-air shrouds. For details, see also the dimension drawings in Section Exhaust-air shrouds (optional) (Page 202).

The mounting procedure is the same for both exhaust-air shrouds.



① Basic shroud
② Cross struts
③ Partition
④ Air deflector (on DC exhaust-air shroud)
⑤ Rubber lug

Figure 6-2 Mounting the exhaust-air shrouds (DC exhaust-air shroud example)

Procedure

1. Ensure that you use the correct exhaust-air shroud for the AC or DC cabinet.
2. Place the rubber lugs on the edges of the exhaust-air shroud.
   The rubber lugs are included in the exhaust-air shroud package.
3. Remove the screws from the top of the cabinet section.
4. Screw the exhaust-air shroud tight on the top of the cabinet section.
   – For this purpose, use the screws and washers from the accessories pack of the exhaust-air shroud.

In the case of the AC cabinet, the supplied foam rubber must also be applied after installation of the exhaust-air shroud to guarantee the desired air flow.

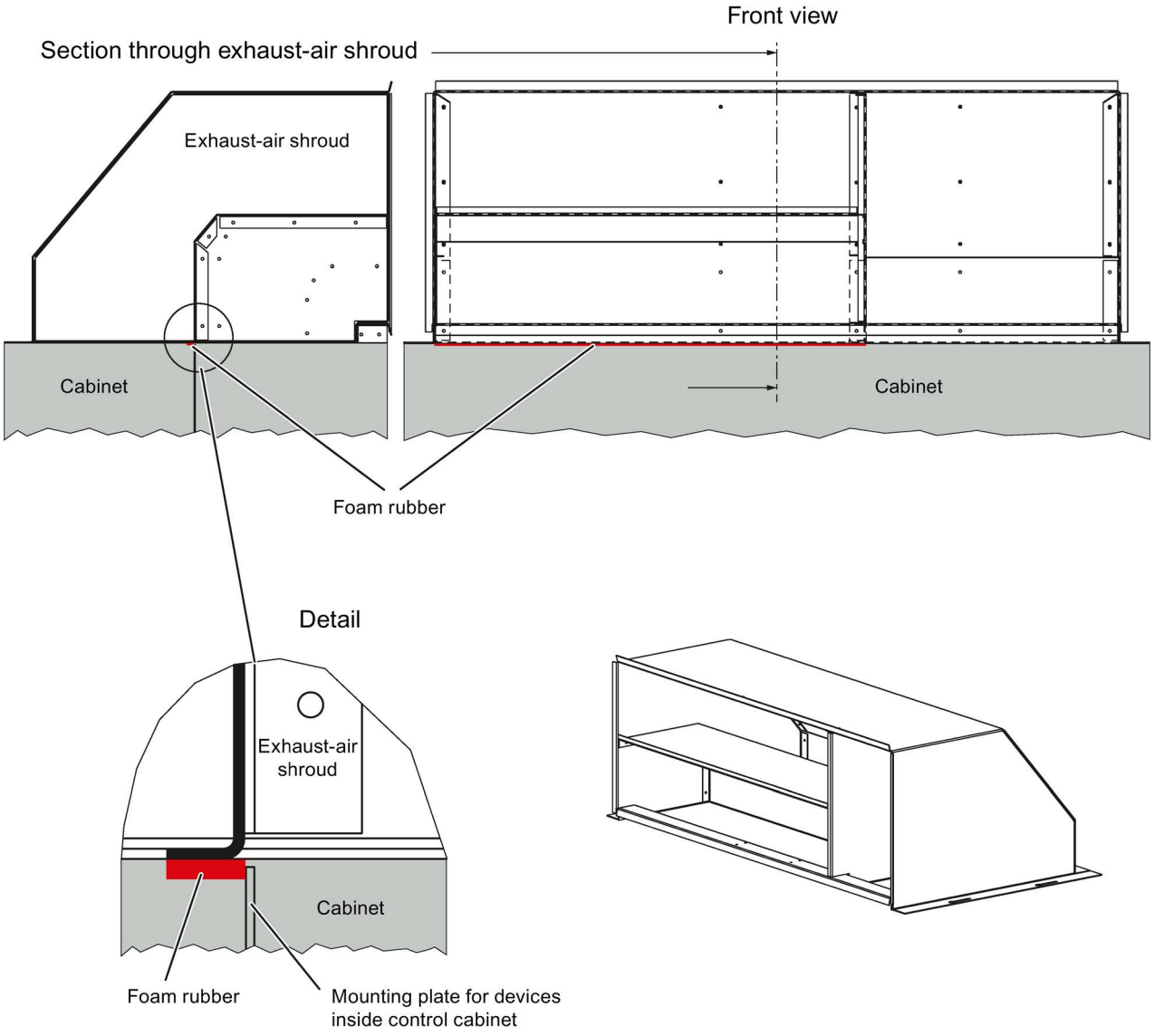


Figure 6-3 Exhaust-air shrouds: Fitting the foam rubber

1. Open the door of the AC cabinet to gain access to the underside of the installed exhaust-air shroud.
2. Apply the foam rubber to the rear, curved surface of the exhaust-air shroud shown in the figure in such a way that no air can escape here into the rear section of the cabinet.

Connecting 7

7.1 Universal safety instructions

For the sake of your own personal safety and to avoid the risk of property damage, follow the safety notices below. Pay particular attention to the safety notes on the actual product and read the documentation and the safety information for all the devices of the system.

⚠ DANGER

Danger due to high voltages

High voltages cause death or serious injury if safety instructions and notices are not observed or if the equipment is handled incorrectly.

⚠ WARNING

Danger from voltages of the PV array

Hazardous voltages from the PV array can exist at the DC input.

The inverter must be isolated from the PV array before starting DC connection work. The electrical isolation can be carried out at the switch disconnector, in the combiner box or at the PV modules or strings.

⚠ WARNING

Danger from voltages from the AC grid

Hazardous voltages from the AC grid can exist at the AC output.
The inverter must be isolated from the AC grid using the medium-voltage switch before starting AC connection work.

⚠ WARNING

Hazardous voltage through residual charges from the capacitors

Potentially fatal voltages from residual charges can occur when this equipment is in operation. These can persist even after the inverter has been switched off.

Before connection work, check the capacitors for residual charges and discharge these if necessary via a discharge resistor.

Observe the five safety rules

Observe the five safety rules during all connection work:

- Isolate
- Protect against reconnection
- Check that voltage is not present
- Ground and short-circuit
- Cover live parts or place guards around them

7.2 Cabling

Use only the cables listed in the tables below.

Table 7- 1 External cable connections: Power supply

	Cable type	Current carrying capacity	Screw type
Grounding	At least 240 mm²	750 A	M12
AC auxiliary power supply	5 x 1.5 mm²	3 phases with 16 A each	Terminal block
AC connection: L1, L2, L3	NSGAFÖU 2 x 300 mm² 1) per phase	1 002 A per phase	M12
DC connection	NSGAFÖU L+: 1 x 300 mm² 1) L-: 1 x 300 mm² 1)	400 A per input	M12
DC link, for master/slave (included in accessories pack)	NSGAFÖU L+: 2 x 300 mm² 2) L-: 2 x 300 mm² 2)	1 200 A	M12

1) If a different cable to the specified NSGAFÖU cable is used, the current-carrying capacity must correspond to the output current.

2) The DC link cables must be short-circuit-proof

Table 7- 2 External cable connections: Communications

	Cable type	Connection
Master-slave communication	PROFIBUS DP cable	PROFIBUS DP connector
Communication (e.g. WinCC)	Patch cable	Patch socket
Rapid stop	2 x 2.5 mm² (shielded)	Terminal
PV field grounding (optional)	NSGAFÖU 1 x 2.5 mm²	Terminal

7.3 Connecting the individual cables

7.3.1 Requirements

This chapter contains information and instructions on how to connect all signal cables and power cables as required prior to initial commissioning.

Requirements

The following requirements must be met prior to starting the individual connection tasks:

- All DC and AC infeed cables to all inverter subunits must be isolated.
- The DC cables must be isolated from the PV array
  The electrical isolation can be carried out at the switch disconnector, in the SINVERT PVS combiner box or at the PV modules or strings.
- The AC cables are isolated from the AC grid using medium-voltage switches.

7.3.2 Overview

Connection of the power cables and all other signal cables must be carried out in the following order:

1. Grounding (Page 112)
2. Signal cables and internal communication (Page 113)
3. Connection for the option "PV array grounding" (Page 118) (if available)
4. External communication (Page 119)
5. Connection between DC and AC cabinet (Page 120)
6. AC auxiliary power supply (Page 121)
7. Main AC grid (Page 122)
8. DC link (only for master-slave combinations) (Page 123)
9. DC input (Page 124)
10. Rapid stop function (Page 125)

An overview of the different terminal compartments of the inverter is shown in the graphic below.

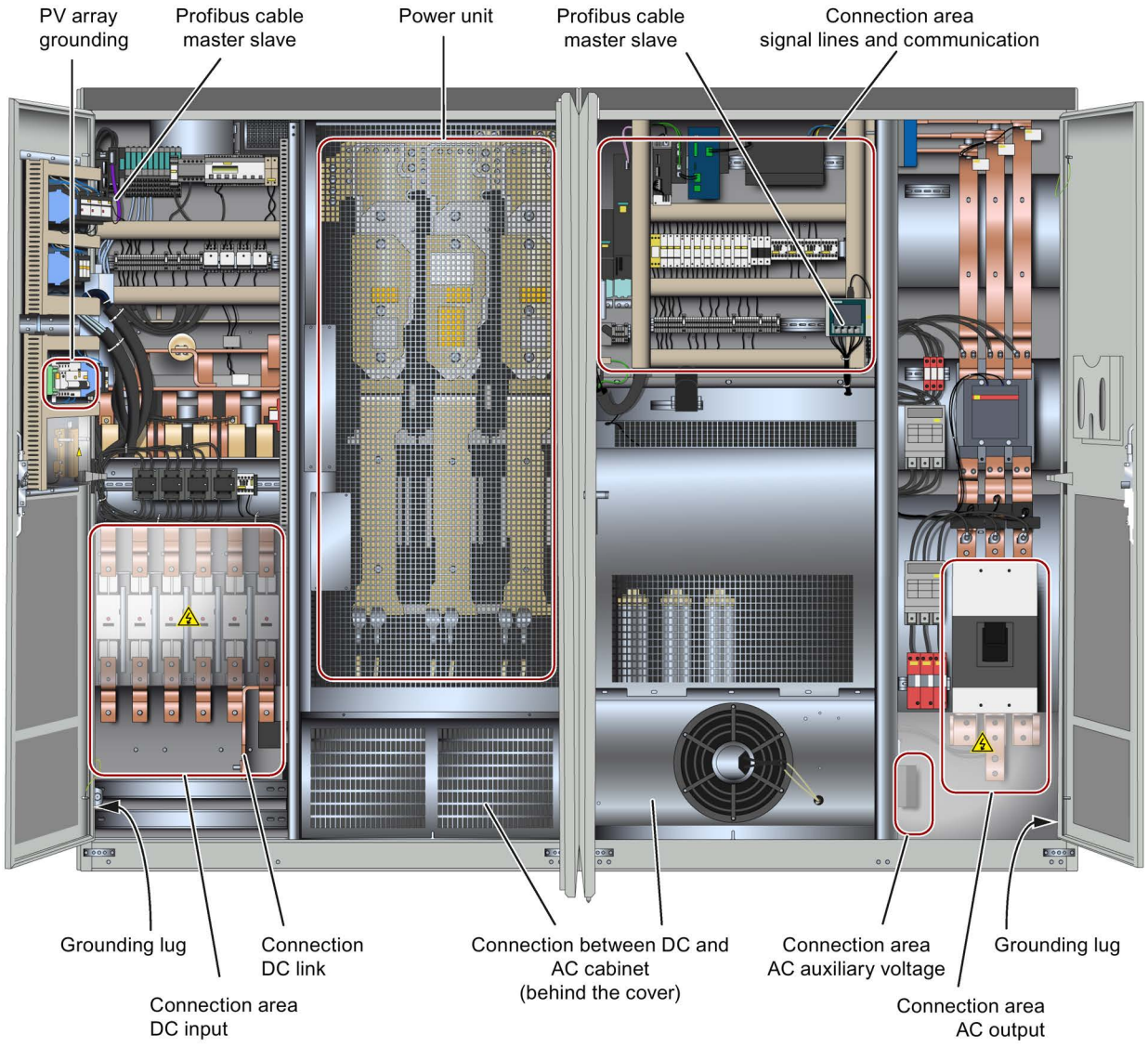

PV array grounding
Profibus cable master slave
Power unit
Profibus cable master slave
Connection area signal lines and communication
Grounding lug
Connection DC link
Connection area DC input
Connection between DC and AC cabinet (behind the cover)
Connection area AC auxiliary voltage
Grounding lug
Connection area AC output

Figure 7-1 The terminal compartments of the inverter

Torques for current-carrying screw connections

The following torques apply for tightening the current-carrying screw-type connections:

Table 7- 3 Torques for current-carrying screw connections

Screw	Torque
AC outputs	70 Nm
DC inputs	70 Nm
Grounding	70 Nm

7.3.3 Grounding

1. Connect every cabinet to ground potential at the grounding lug (see figure in Chapter Overview (Page 110)) using an appropriate cable.
   - The grounding cables must have a minimum cross-section of 240 mm².
   - See also the External cable connections table in Chapter Cabling (Page 109).
2. Tighten the screw connections of the grounding connection with a torque of 70 Nm.

7.3.4 Signal cables and internal communication

Signal cables

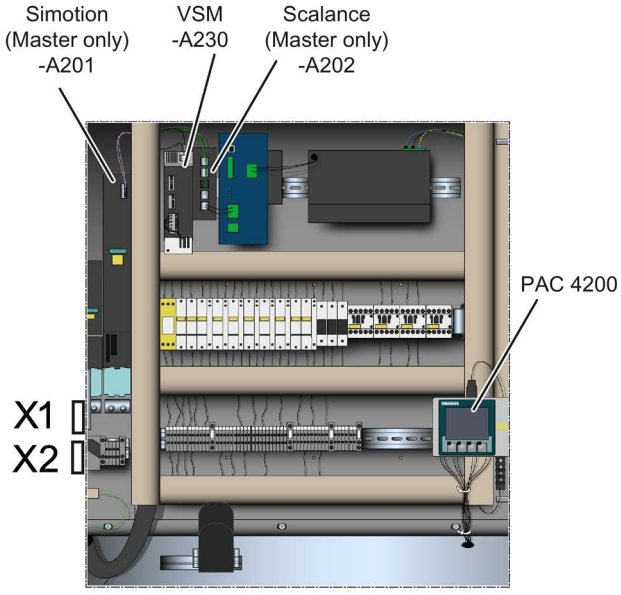


Figure 7-2 Communication terminal compartment

1. Insert the signal cables with the connectors X1 and X2 into the X1 and X2 sockets provided for this on the left frame of the AC cabinet.
2. Connect the marked signal cables of the DC cabinet and the Profibus DP cable of the DC cabinet with the associated connections of the modules -A201 (Simotion) and -A230 (VSM) of the AC cabinet:
   - Simotion module -A201 connection -X126 (Profibus)
   - Simotion module -A201 connection -X100 (Drive Cliq connection)
   - Simotion module -A201 connection -X101 (Drive Cliq connection)
   - VSM module -A230 connection -X500

Note

Observe the labeling when securing the Drive Cliq connections. If the two connections are mixed up, the system will not function.

Profibus connection in the case of master/slave combinations

In the case of master/slave combinations, establish the Profibus connection between the master and the slaves using the specified cables (see Chapter Cabling (Page 109)).

Note

Terminating resistors

You must note the following in the case of the first and last PROFIBUS nodes:

(The first PROFIBUS node is always the ET200S of the master.
The last PROFIBUS node is the PAC 4200 in the last slave.)

- The PROFIBUS cable must be connected to "IN".
- The terminating resistor must be set to "On".

Connection on the master

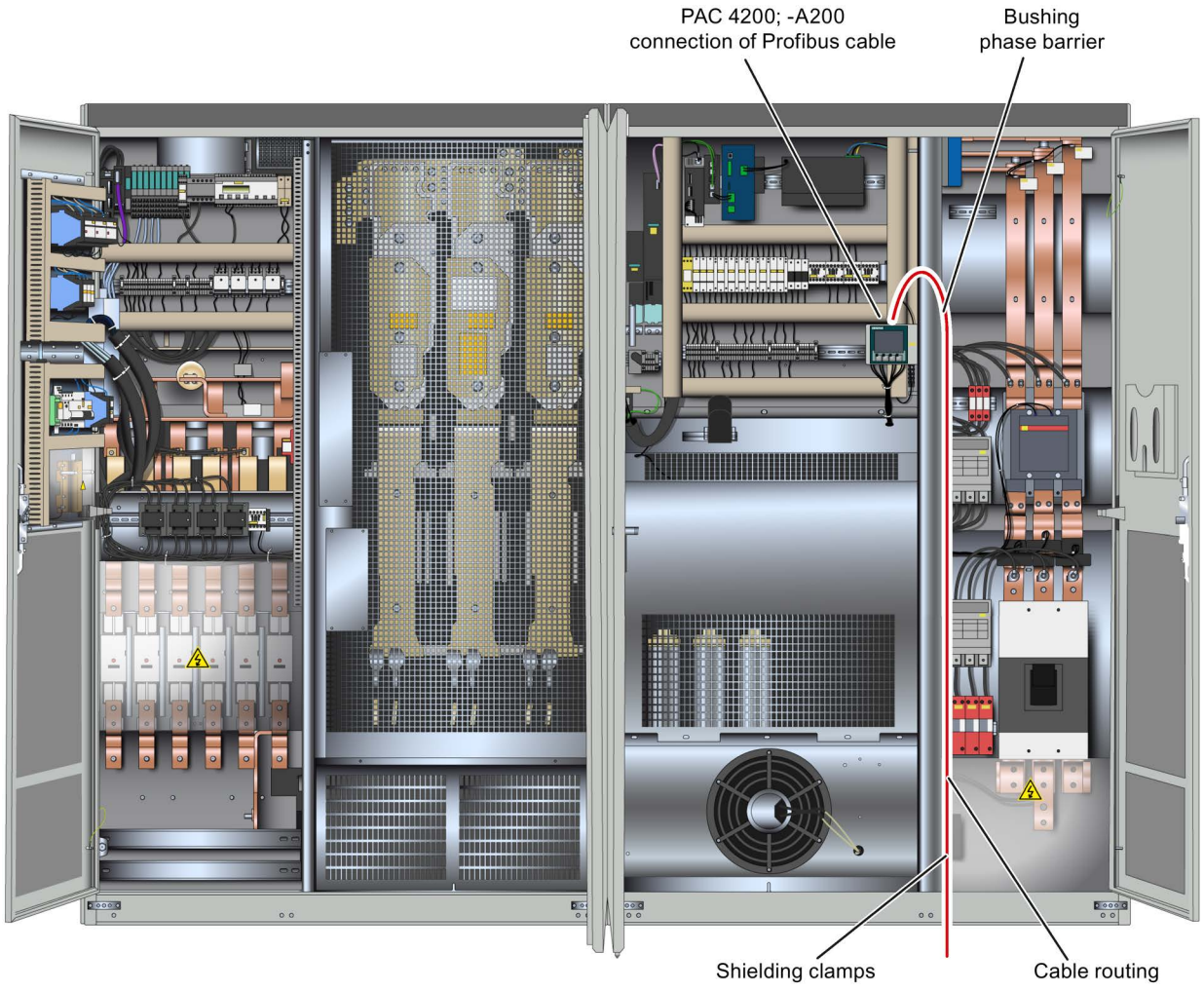


Figure 7-3 Running the Profibus cable in the master

1. Run the Profibus cable into the bottom of the AC cabinet and then up and through the hole in the partition to the PAC 4200 as shown in the drawing.
2. Connect it to the PAC 4200 (-A200).
   – To do so, open the connector (6GK1500-0FC10) and connect the red and green core of the cable to the contacts with the same core colors.
3. Connect the shield of the Profibus cable to the shield terminals in the AC cabinet.
4. Secure the cable at suitable points with cable ties.

Connection on the slave

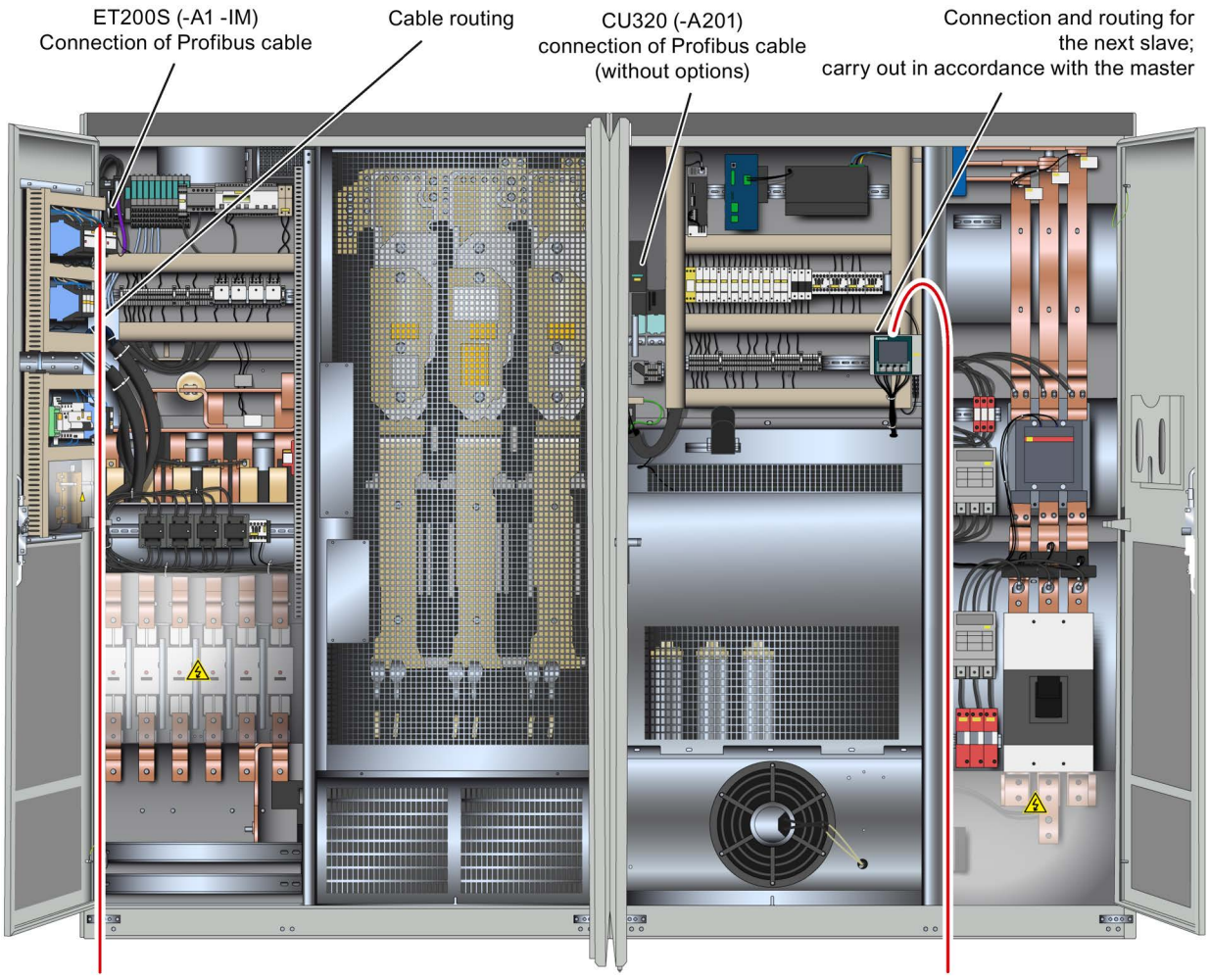


Figure 7-4 Running the Profibus cable in the slave

1. Insert the cable into the DC cabinet from bottom left, and run it up the frame as shown in the drawing.
2. Connect it to the ET200S (-A1 -IM).
   – To do so, open the relevant connector and connect the red and green cores of the cable to the contacts with the same core colors.
3. Connect the shield of the Profibus cable to the shield terminals in the DC cabinet.
4. Secure the cable at suitable points with cable ties.

The Profibus cable to the next slave is to be laid as described for the master and connected to the PAC 4200.

Connection on the slave if there is no option available

If none of the following options is available

- D30/D40 PV: Field grounding,
- D61: Max. DC voltage 1000 V,
- M10: Symmetry monitoring,

there is no ET200 in the DC cabinet and the Profibus cable must be connected in the slave to the module CU320 (see figure "Running the Profibus cable in the slave").

1. Connect the Profibus cable to the CU320 (-A201).
   – To do so, open the connector (6ES7972-0BB60-0XA0) and connect the red and green cores of the cable to the contacts with the same core colors.

7.3.5 Connection for the option "PV array grounding"

In the case of the PV array grounding option, the relevant cable connections must be established between the master and the slave cabinets.
The connecting cable is located in the slave and is already connected there. It only has to be run to the master and connected.

The following connections must be made:

Master	Terminal –X510 – 12	Slave 1	Terminal –X510 -11
	Terminal –X510 - 13	Slave 2	Terminal –X510 -11
	Terminal –X510 – 14	Slave 3	Terminal –X510 -11

Cable laying is identical on the master and slave.

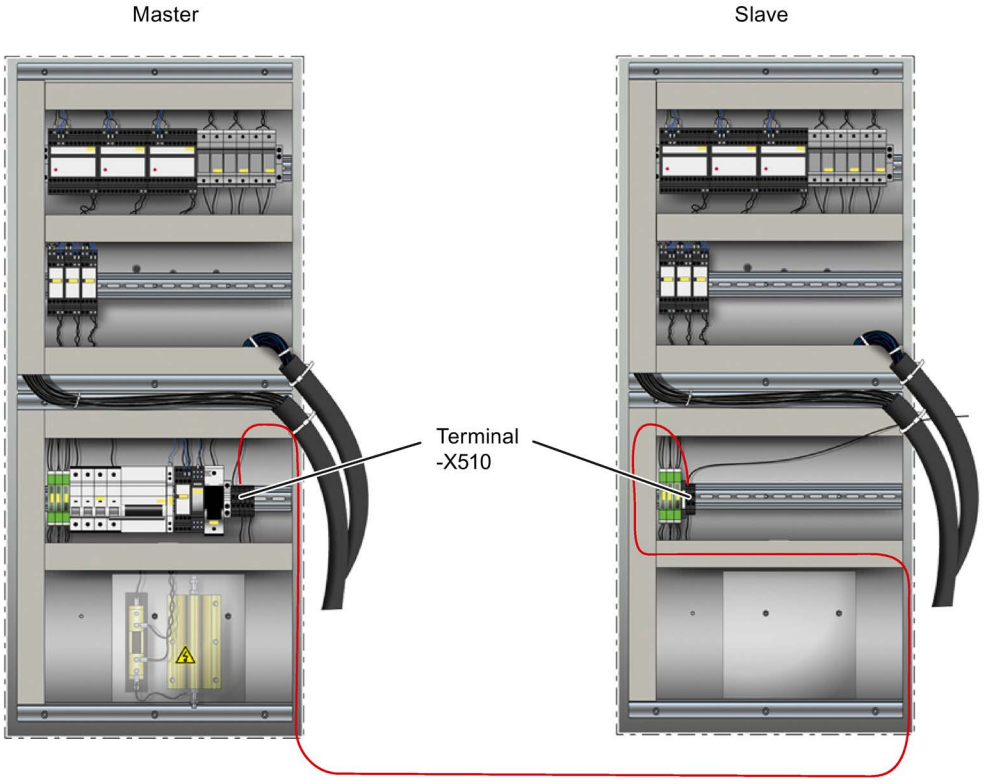


Figure 7-5 Connection of the PV array grounding

Procedure

1. Take the cable already connected in the slave and run it to the master.
2. Insert the cable into the DC cabinet of the master from the bottom left, run it up the frame and on through the cable ducts of the door (see figure above).
3. Connect the cable to the terminal –X510 in the door of the DC cabinet (see table above).

7.3.6 External communication

To establish communication with the "outside", a connection to the Internet is established via a router.

For this purpose, connect the relevant cable with the associated connection of the SCALANCE module -A202 in the AC cabinet.

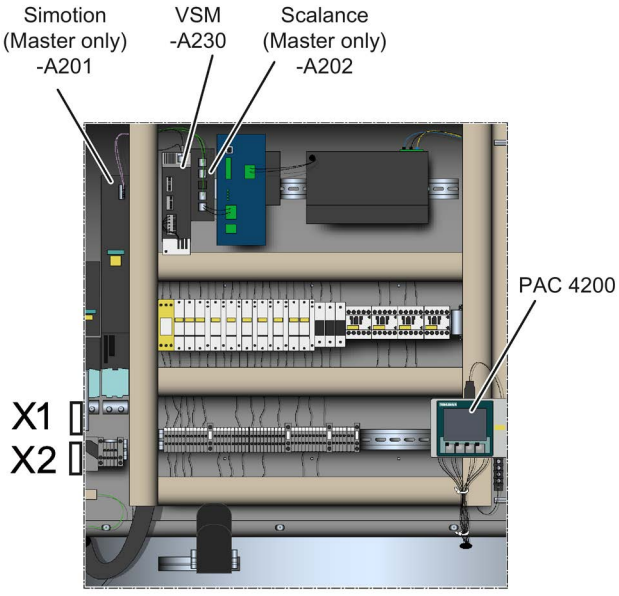


Figure 7-6 Innenansicht_Kommunktion

1. Insert the cable into the bottom of the AC cabinet and run it up and through the hole in the partition and on by a suitable route through the cable ducts to the SCALANCE module -A202 as shown in Figure 7-3 Running the Profibus cable in the master (Page 115) for the Profibus cable.
2. Connect the shield of the Profibus cable to the shield terminals in the AC cabinet.
3. Connect the cable on the module -A202, terminal -X500.
   – Use a free connection of the terminals P1-P5.

See also

Signal cables and internal communication (Page 113)

7.3.7 Connection between DC and AC cabinet

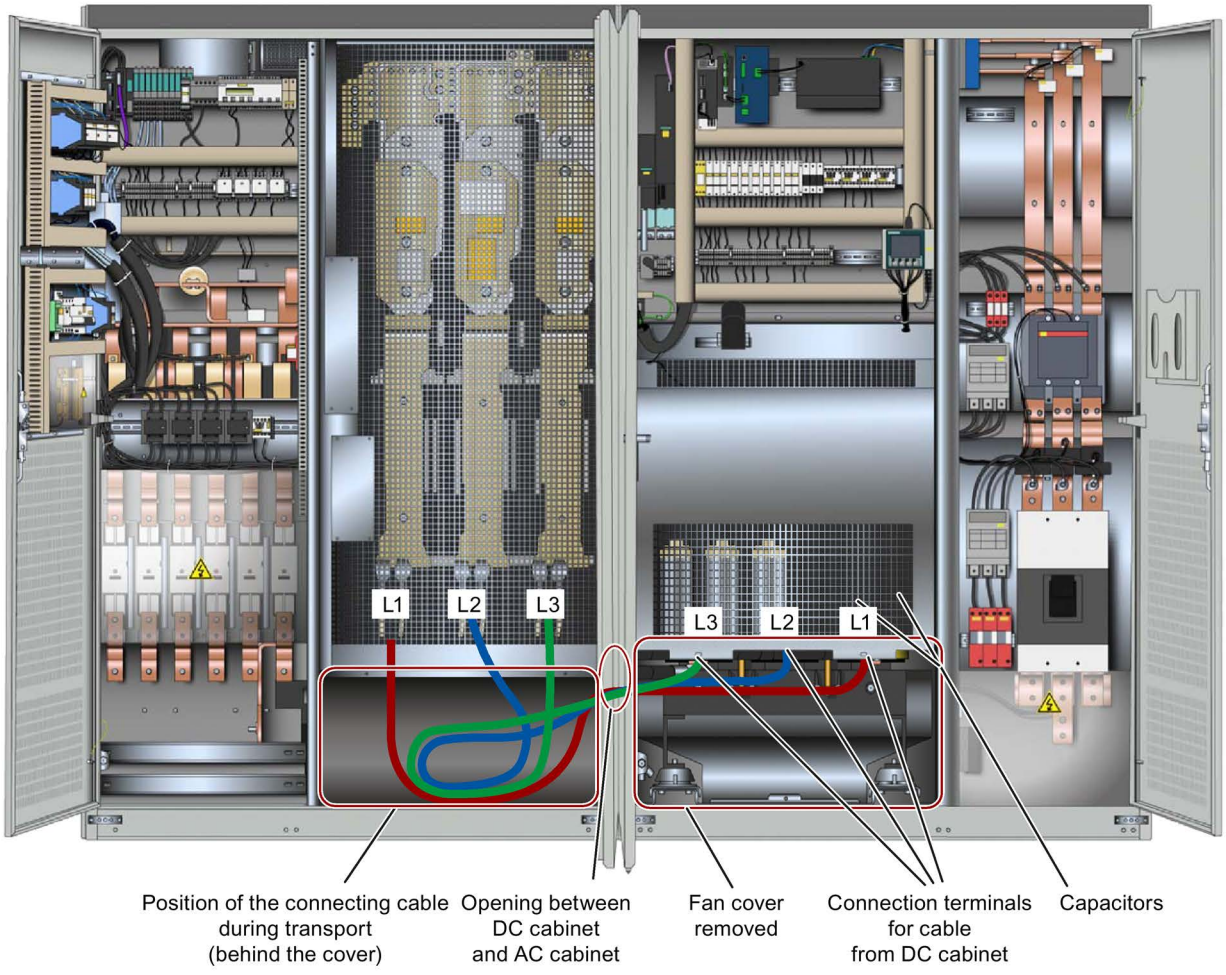


Figure 7-7 Making the connection between the DC and AC cabinet

1. Remove the cover at bottom-right of the DC cabinet.
2. Remove the fan unit at bottom-left of the AC cabinet.
3. Take the longest double cable **L3** from the area under the inverter power supply unit and run it through the side opening on the right into the AC cabinet.
4. Connect the double cable L3 to the left copper bar of the reactor in the AC cabinet.
   – Tighten the screw connections with a torque of 70 Nm.
5. Take the middle double cable **L2,** run it through the side opening in the AC cabinet, and connect it to the middle copper bar of the reactor in the AC cabinet.
   – Tighten the screw connections with a torque of 70 Nm.
6. Take the shortest double cable **L1,** run it through the side opening in the AC cabinet, and connect it to the right copper bar of the reactor in the AC cabinet.
   – Tighten the screw connections with a torque of 70 Nm.
7. Install the fan unit in the AC cabinet and replace the cover in the DC cabinet.

7.3.8 AC auxiliary power supply

The inverters are supplied with an auxiliary voltage of 400 V.

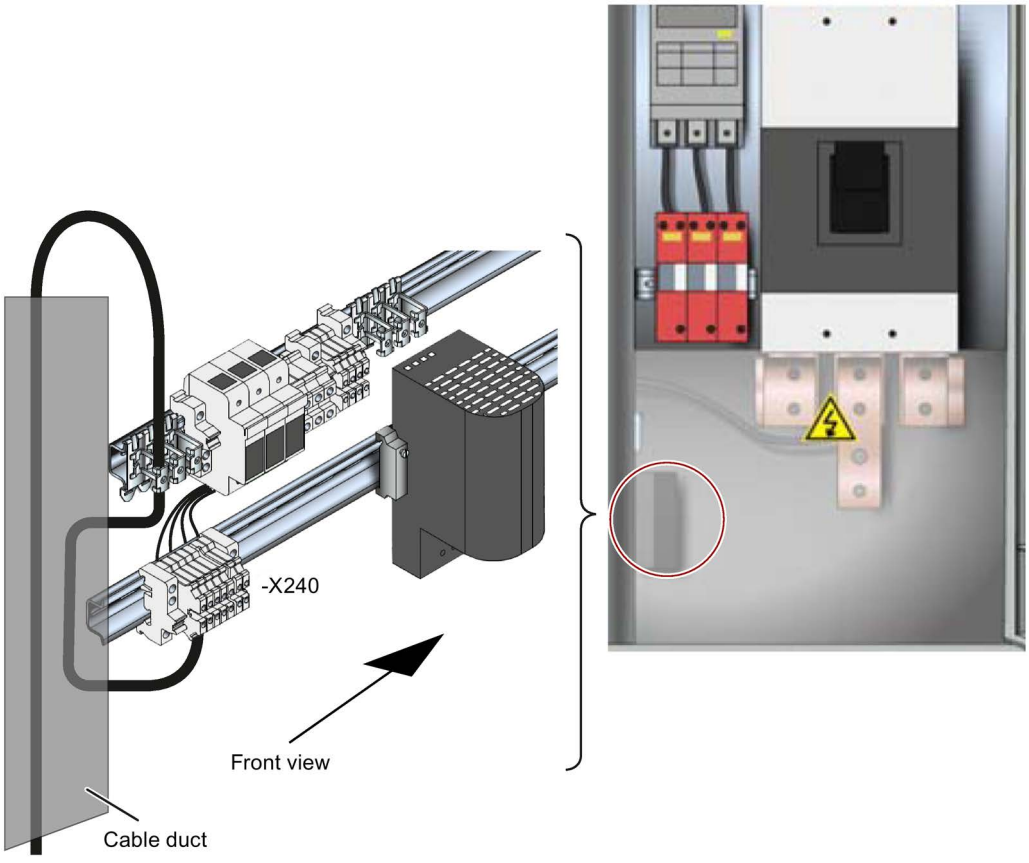


Figure 7-8 Connection of AC auxiliary power supply

1. Run the 3-phase cable for the AC auxiliary power supply as shown in the figure, and connect the three phases (L1,L2,L3,N, PE) to the terminal block –X240 (see Appendix Overview of master slave cabling (Page 211)).
2. Secure the cable of the AC auxiliary power supply to the cable clamp strip above this to guarantee strain relief (see figure above).

7.3.9 Main AC grid

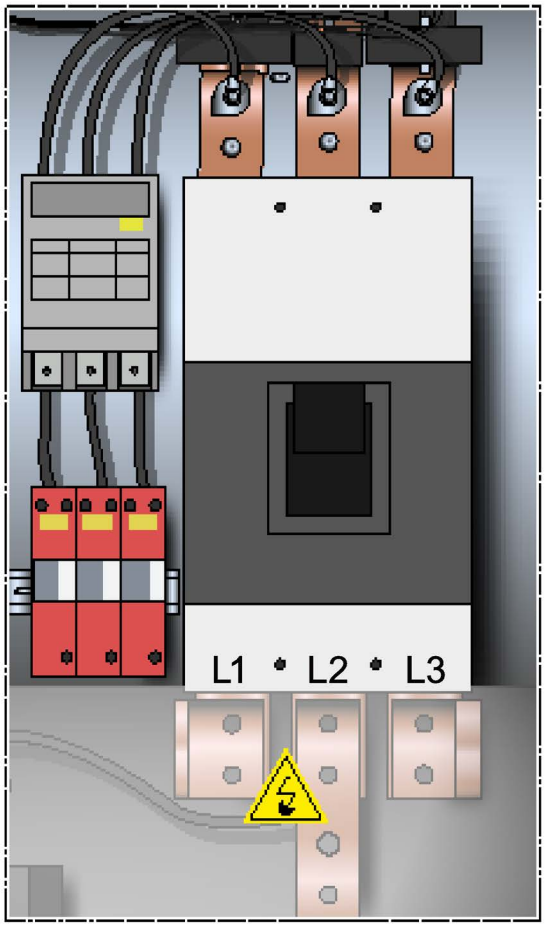


Figure 7-9 AC connection

1. Connect the AC power cable to the terminals L1, L2 and L3.
2. Tighten the screw connections of the AC connection with a torque of 70 Nm.
3. Secure the AC power cable to the cable clamping strip to guarantee strain relief.

Note

Connection at the medium-voltage transformer

Each subunit of the inverter must be connected to the medium-voltage transformer with galvanic isolation.

7.3.10 DC link (only for master-slave combinations)

This connection must **only** be made in the case of master/slave combinations.

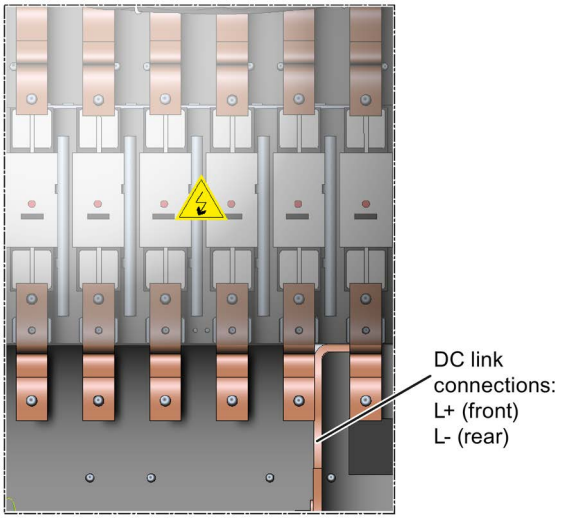


Figure 7-10 DC link connection

Ensure that the DC link is free of voltage.

1. Connect the DC link power cables to the copper bars marked "L+" and "L-" an.
   - Copper bar "L+" is at the front and "L-" behind it
   - The DC link cables are double cables. For this reason, one cable must be applied to the terminal bar at the front and the other behind.
   - It is essential to ensure correct polarity.
2. Tighten the screw connections of the DC link connection with a torque of 70 Nm.
3. Secure the DC link power cable to the cable clamping strip to guarantee strain relief.

Note

DC link ring in the case of 3 subunits

If three slaves are connected, the DC link must be laid as a ring so that the master is connected to both slave 1 and slave 3:

Master - Slave1 - Slave2 - Slave3 - Master

With less than 3 slaves, this is not necessary.

7.3.11 DC input

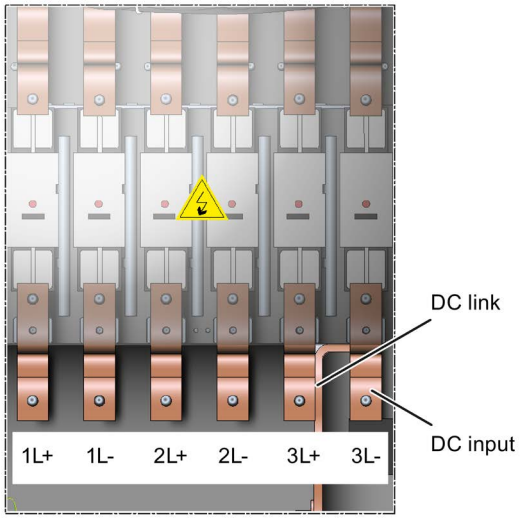


Figure 7-11 DC connection

1. Ensure that the DC power cable is isolated on the PV side.
   - For this purpose, the PV field must be isolated by a switch disconnector or at the combiner box.
2. Connect the DC power cables to the terminals 1L, 2L and 3L.
   - The DC power cables are double cables. For this reason, one cable must be applied to the terminal bar at the front and the other behind.
   - It is essential to ensure correct polarity.
3. Tighten the screw connections of the DC connection with a torque of 70 Nm.
4. Secure the DC power cable to the cable clamping strip on the side to guarantee strain relief.

7.4 Rapid stop function

The "rapid stop function" is used for fast shutdown of the AC grid in the event of faults. Installation of a corresponding external switch with this function is therefore absolutely necessary.

⚠ WARNING

Without the rapid stop function, shutdown of the AC grid in the event of faults is not possible.

If no rapid stop function is installed, the inverter subunit cannot be separately isolated.

Block diagram

To implement the feature, a jumper in the AC cabinet must be removed and replaced with an electrical connection to the external rapid stop switch.

The precise interconnection can be seen from the block diagram below.

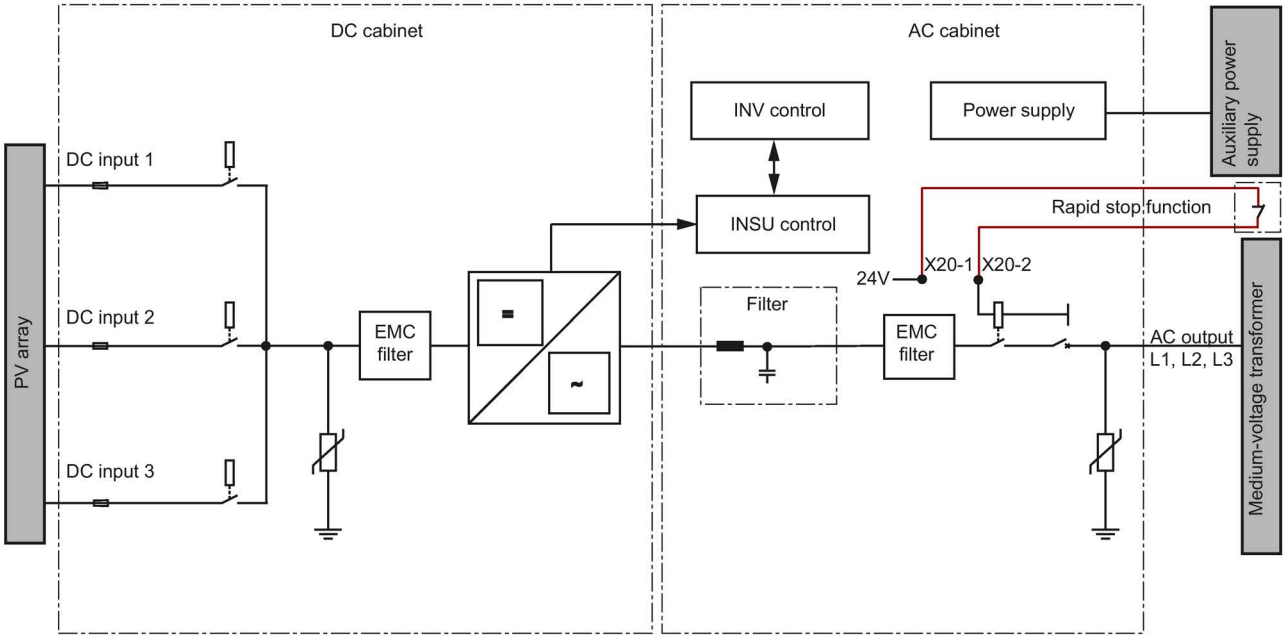


Figure 7-12 Block diagram for rapid stop function

Requirements for switch and cable

- Switch (NC) designed for 16 A DC
- Shielded cable 2 x 2.5mm^2

Procedure for installation and connecting

1. Install the rapid stop switch at a suitable, easily accessible point close to the cabinet. The distance to the cabinet must be less than 10 m.
2. Lay a 2-core shielded cable (2.5mm^2) and connect it to the rapid stop switch.
3. Remove the jumper between the terminals X20 -1/-2 in the AC cabinet.
4. Insert the cable from the rapid stop switch into the bottom of the AC cabinet, and run it on to the terminal X20 as shown in the figure below.
5. Connect the cable to the terminal X20-1/2.

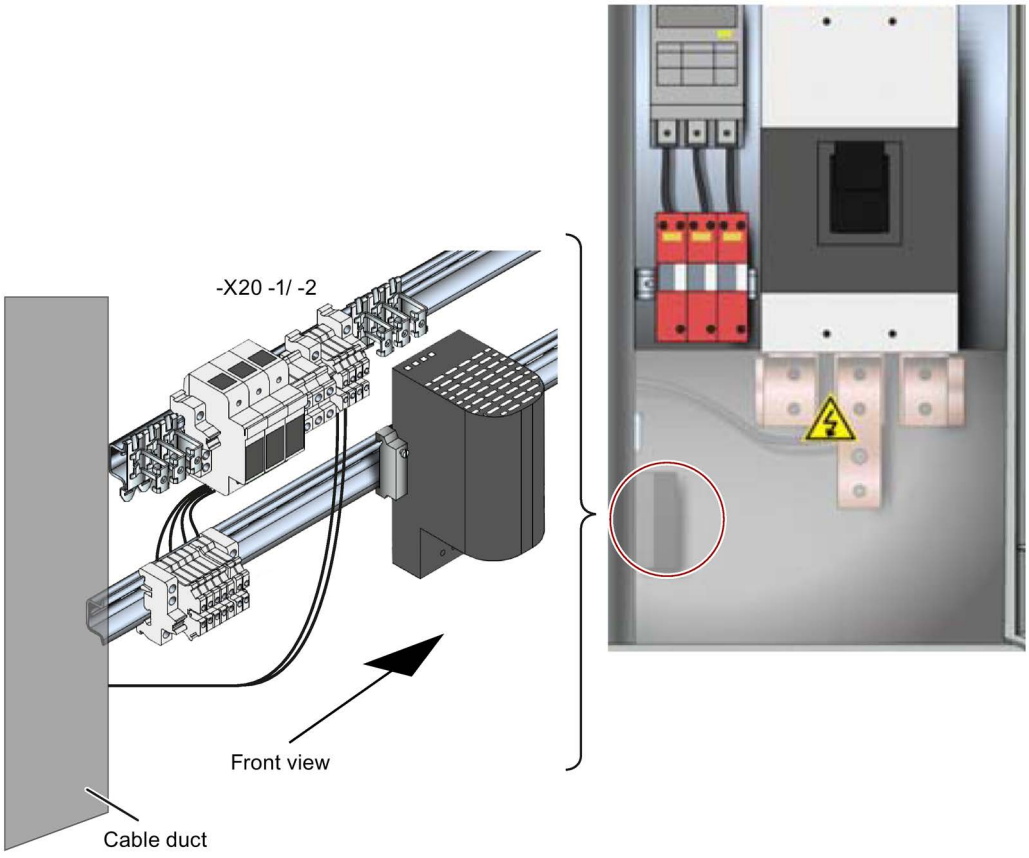


Figure 7-13 Connecting terminal for rapid stop function

Commissioning

8

8.1 Overview

Commissioning of the PVS inverter must be carried out by qualified Siemens personnel.

The following steps must be carried out for commissioning:

On the master

1. Connect the AC auxiliary power supply
2. Connect AC voltages to the connecting cable and check phase sequence
3. Connect DC voltages to the connecting cable and check polarity
4. Configure basic settings using the touch panel
   (menu language, system time, IP address, options)

   The settings are valid for the entire inverter system
5. Make further parameter settings and adapt them to the requirements of the system
   (note the national parameters here)

   The parameter settings are valid for the entire inverter system
6. Enable the PVS cabinet using the key-operated switch (position 2)

At the slaves

1. Connect the AC auxiliary power supply
2. Connect AC and DC voltages to the connecting cable
3. Enable the PVS cabinet using the key-operated switch

Note

If the inverter does not start after switching the key-operated switch to "Position 2", check whether remote activation is switched on in the HMI. This can be done in the HMI under "Service/Other/Other 3".

8.2 Commissioning the inverter

The procedure described below applies for the complete inverter unit.
We recommend that you commission the inverter "master" subunit first and then the slave subunits.

Requirements

- The cabinet has been installed correctly.
- The cabinet has been connected up correctly.
- The rapid stop switch is installed.
- The green "READY" indicator light in the control cabinet door does not light up.

Procedure for master

1. Switch on the voltage of the AC auxiliary power supply
   - The electronics are supplied with power, and system initialization starts.
   - The green indicator light (operation state indicator) flashes slowly
   - The touch panel display is activated.
2. Configure the basic settings using the touch panel (see the chapter Commissioning the inverter (Page 128))
   - Select language
   - Set the system time
   - Enter IP address
   - Activate options
3. Adapt the system parameters to the requirements of the system (see the chapter Parameterizing the inverter (Page 133)).
4. Switch the AC circuit breaker on (position "1").
5. Switch on the voltage of the AC connecting cables to the main grid.
6. Check the phase sequence of the AC network with a phase sequence indicator.
   - If the phase sequence is incorrect, 2 phases have to be swapped in the connection area of the AC output (see Chapter Main AC grid (Page 122)).
7. Switch on the voltage of the DC connecting cables from the PV array.

8. Check the polarity of the DC voltage with a suitable measuring device (e.g. multimeter)
   – If the polarity is incorrect, the corresponding power cables have to be swapped in the connection area of the DC input (see Chapter DC input (Page 124)).
9. Turn the key-operated switch in the AC cabinet door to the position "2-Enable".

Note

If the inverter does not switch on, check for remote activation in the HMI

If the inverter does not start after switching the key-operated switch to position "2", check whether remote activation is switched on in the HMI. This can be done in the HMI under "Service/Other/Other 3".

Procedure for slaves

1. Carry out steps 1 and 4 to 9 specified for the master.

Results

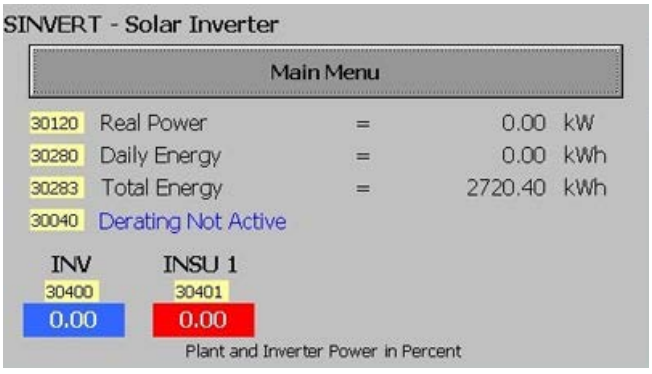
- The green indicator light ("Ready") in the cabinet door flashes quickly or the touch panel displays the operation state "System - running".
- The inverter is in the "Ready" state.
- The inverter automatically switches to the "Grid feed" state if the following conditions are met:
  – No fault present.
  – The PV array is supplying a sufficiently high voltage.
  The threshold value for sufficient voltage is defined in Chapter Electrical data (Page 187).

Language selection

After switching on the power supply, the screen for language selection is the first to appear on the touch panel of the master. (For more information on operating the touch panel, see also Chapter Operating and monitoring the inverter via the touch panel (Page 141))

1. Select the desired language and confirm with OK.

   After a language has been selected, the start window appears:

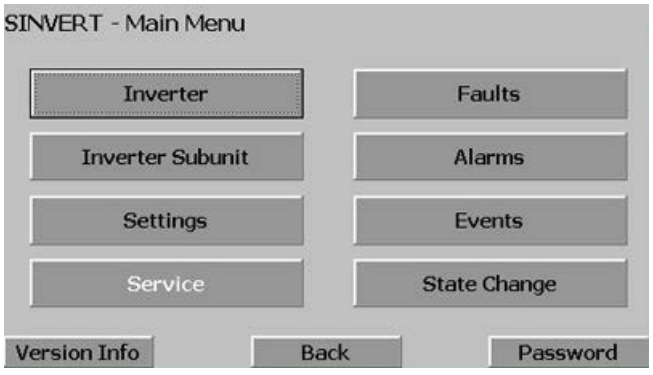


Set the system time

Proceed as follows to set the system time:

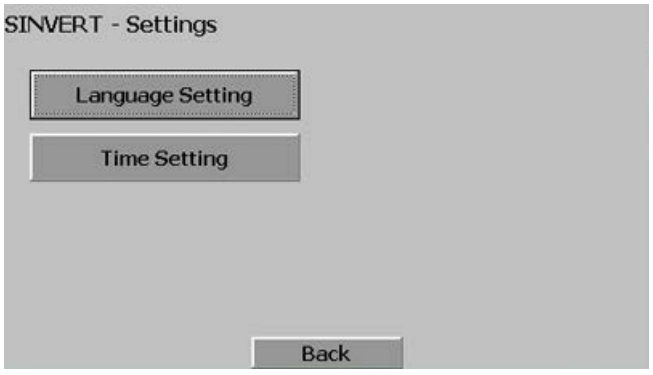
1. In the start window, touch the "Main Menu" button in the upper area of the touch screen.

   The main menu is displayed:



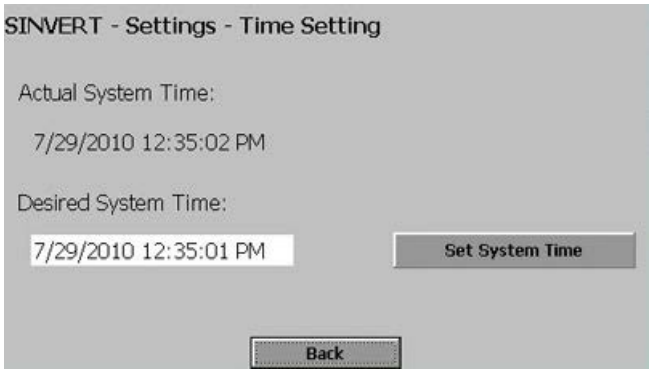
2. Touch the "Settings" button.

   The "SINVERT - Settings" menu is displayed:

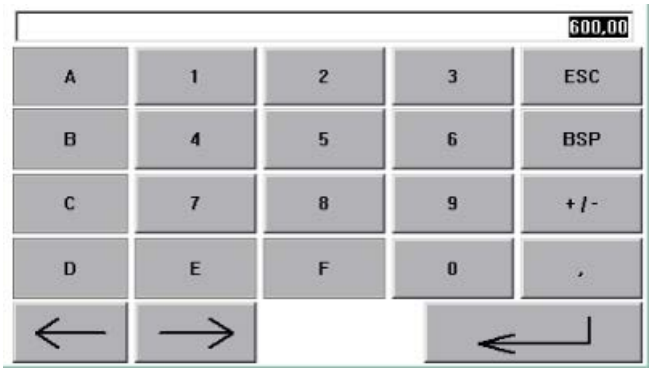


3. Touch the "Time Setting" button.

   The screen form for entering the system time is displayed.



4. Touch the field "Desired System Time" and enter the desired date and time-of-day with the numerical keypad.



   – Use the arrow keys to change the cursor position within the line.
   – Use the "BSP" button to delete one character at a time at the cursor position.
   – Use the the "ESC" button to exit the window without changes.
   – Use the "Return" button to confirm the input and exit the window.

     The entered time including the date is displayed as the "Desired System Time".

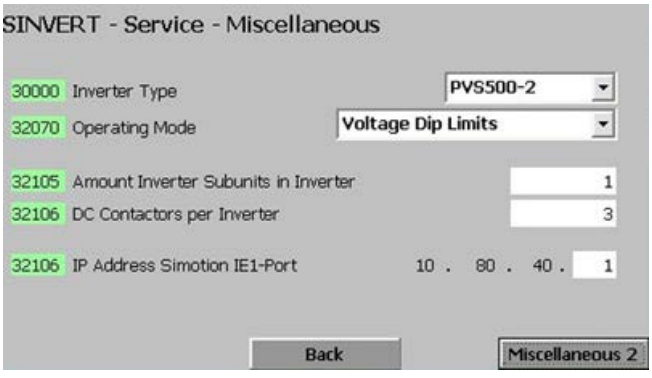
5. To save the entered "Desired System Time" as the current system time, touch the button "Set System Time".
   – If you do not want to accept the "Desired System Time", touch the "Back" button.

Enter IP address Simotion IE1-Port

A unique IP address must be assigned to every master.

1. To set the IP address, select the menu sequence "Main Menu - Service - Miscellaneous".

   The following screen form is displayed.



2. At "IP Address Simotion IE1-Port", enter the last digit of your port number.

8.3 Parameterizing the inverter

Adapt inverter to system requirements

Depending on the application, it is necessary to adapt the inverter to specific system requirements by modifying parameters. You can find the available setting parameters in Chapter Operator control and monitoring (Page 137).

The parameters of the inverter have pre-assigned values. These values must be checked during commissioning and adapted if necessary.

Observe country-specific grid monitoring parameters

The system settings must be adapted to country-specific requirements regarding grid monitoring parameters. The system settings can be appropriately set and modified via the service pages in the menu. Only authorized service personnel have access to the service pages via a password.

NOTICE
Withdrawal of operating permit and warranty If you operate SINVERT PVS with incorrect grid monitoring parameters, the electrical utility can withdraw your operating permit. Only authorized service personnel are permitted to commission the inverter and adapt the system settings to the country-specific grid monitoring parameters. Otherwise the warranty will expire. Commissioning is prohibited until the total system conforms to the national regulations and safety rules of the application.

We assume no responsibility for incorrect grid monitoring parameters.

8.4 Decommissioning the inverter

8.4.1 Decommissioning an inverter subunit

With the SINVERT PVS, an inverter subunit can be decommissioned individually. This means that if an error occurs in one inverter subunit, the other inverter subunits can remain in operation.

Procedure

1. Turn the key-operated switch in the AC cabinet door of the inverter subunit to be switched off to the position "1-Lock".
   – The complete inverter shuts down and switches on again after 30 s in a controlled fashion, apart from the inverter subunits on which the key-operated switch is in the "1-Lock" position. These inverter subunits are now decommissioned.
2. Wait until the green indicator light (operation state indicator) in the control cabinet door of the inverter subunit flashes slowly (operating state "IDLE").

⚠ WARNING
Hazardous voltages in the switched-off inverter subunit
The switched-off inverter subunit and the supply lines of the DC and AC inputs are still live.

Results

- The green "READY" indicator light in the control cabinet door does not light up.
- The inverter subunit is locked but the supply lines are still live.
- The remainder of the inverter is still in operation.

⚠ WARNING
Hazardous voltages on the supply lines
The supply lines of the DC and AC inputs are live.

8.4.2 Decommissioning the entire inverter

In order to work on a SINVERT PVS inverter, the whole inverter unit must be isolated. This means that all inverter subunits must be decommissioned.

Procedure

1. Turn the key-operated switch in the AC cabinet door on **all** inverter subunits to the position "1-Lock".
   - After the first subunit is switched off, the complete inverter shuts down and attempts to switch on again after 30 s in a controlled fashion, apart from the inverter subunits on which the key-operated switch is already in the "1-Lock" position.
   - Therefore, all inverter subunits should be switched off rapidly because the inverter will try to switch on the remaining subunits again.
2. After all inverter subunits have shut down, wait until the green indicator light (operation state indicator) in the control cabinet door of each inverter subunit flashes slowly (operating state "IDLE").
3. Open the cabinet doors.

⚠ WARNING

Hazardous voltages in the inverter cabinet

The inverter is live.

4. Set the circuit breaker in the AC connection section to "0".
5. Switch off the auxiliary power supply.
6. Switch off the DC voltage (PV array).
7. Use a measuring device to check there is no voltage at the DC and AC inputs.

Results

- The green "READY" indicator light in the control cabinet door does not light up.
- The inverter is locked and the cabinet is isolated.

⚠ WARNING

Hazardous voltages on the supply lines

The supply lines of the DC and AC inputs are live.

Operator control and monitoring

9

Only qualified personnel may operate the inverter.

9.1 Operation states

The SINVERT PVS inverter can have the following operation states:

Table 9- 1 Description of the operating states

Operating state	Display	Description
"Off"	Green and yellow indicator lights do not light up	The SINVERT PVS inverter is has shut down on the AC side or the controller has failed
IDLE	Green indicator light flashing slowly, 1s cycle	The SINVERT PVS inverter is waiting for key switch or remote activation. The key switch is not in position "2" or the remote activation on the HMI is set to "Off".
READY, STARTING	Green indicator light flashing fast, 250ms cycle	The SINVERT PVS inverter is enabled. The inverter automatically switches to the "RUN" state if the following conditions are met: • No fault present. • Wait time for reclosing after faults not yet expired. • The PV array is supplying a sufficiently high voltage. The minimum voltage threshold value is defined in the "Electrical Data" chapter.
RUN	Green indicator light on constantly	The SINVERT PVS inverter is feeding energy into the connected power distribution grid.
ALARM	Yellow indicator light flashing slowly, 1s cycle	The controller has signaled an alarm. The inverter subunit remains in operation, but maintenance is required. The type of maintenance work required can be established by reading the warning texts or can be obtained from Siemens Service.
FAULT	Yellow indicator light flashing fast, 250ms cycle	The controller has reported an error, which is automatically acknowledged after a wait time once the fault no longer exists. The inverter subunit will start up again after the fault has been acknowledged.
	Yellow indicator light on constantly	The controller has signaled an error. This error must be corrected by qualified personnel and then manually acknowledged. The SINVERT PVS inverter is not in operation. For details see Chapter Fault, alarm and system messages (Page 153)

9.2 Parameters

The inverter functions are adapted to the specific plant requirements using parameters. These parameters are stored in the software of the SINVERT PVS inverter.

- A unique number is assigned to each parameter.
- A large number of parameters can be accessed via the touch panel.
- Some parameters are only accessible for communication via the Ethernet interface.

Parameter types

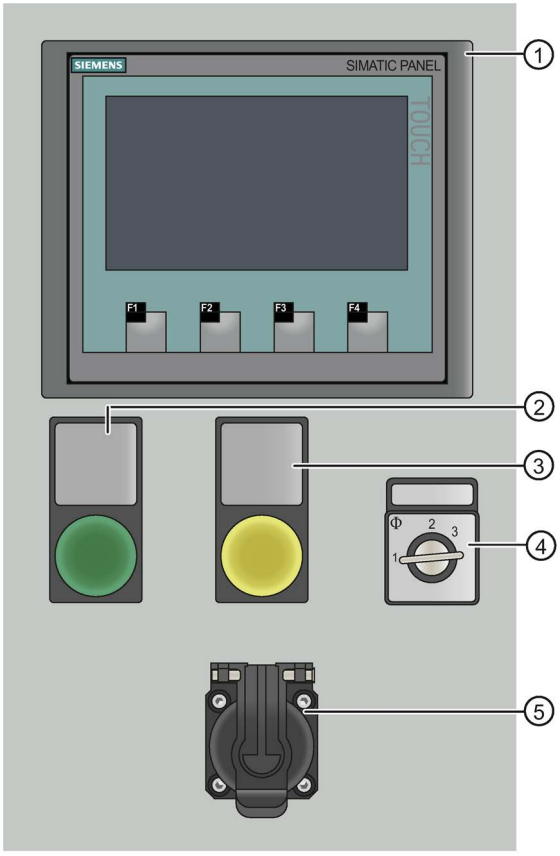
The following parameter types are distinguished:

- Readable parameters are used for monitoring the inverter and cannot be modified by the user.
- Writable parameters are used for adapting the inverter functions and can be modified by the user.

9.3 Controlling the inverter via the operator panel

Design of the operator and display panel

The operator and display panel of the SINVERT PVS inverter unit in the AC cabinet door of the master is designed as shown below.



① Touch panel (master only)
② Green indicator light (operation state indicator)
③ Yellow indicator light (fault indicator)
④ Key-operated switch
⑤ Service interface: Industrial Ethernet (master only)

Figure 9-1 Operator and display panel

Control and display elements

You can enable and disable an inverter subunit via the key-operated switch in the control cabinet door. The display elements also indicate the status of the inverter subunit.

Table 9- 2 Description of the display elements

Display element	State	Description
Green indicator light "RUN"	Not illuminated	No infeed voltage on the AC side of the SINVERT PVS inverter, or the Control Unit has failed.
	Flashing slowly, 1s cycle	The key-operated switch is not in position "2" or the remote activation in the HMI is set to "Off". The inverter subunit is in the operating state "IDLE".
	Flashing fast, 250ms cycle	The inverter subunit is in the "READY" state.
	Illuminated steadily	The inverter subunit is in the "Grid feed" state. The inverter subunit is feeding energy back into the grid.
Yellow indicator light "FAULT"	Not illuminated	No faults detected.
	Flashing slowly, 1s cycle	The Control Unit has signaled an alarm. The inverter subunit remains in operation, but maintenance is required.
	Flashing fast, 250ms cycle	The Control Unit has signaled a fault which will be automatically acknowledged after a wait period. The inverter subunit will start up again after the fault has been acknowledged.
	Illuminated steadily	The Control Unit has signaled a fault which you need to acknowledge manually.

Table 9- 3 Description of the operator controls

Operator control	Position	Description
Key-operated switch "1/2/3"	1-Lock	The inverter subunit is waiting to be enabled.
	Transition from 1 to 2	By turning the key-operated switch from position "1" to position "2", you will manually acknowledge all active faults.
	2-Enable	The inverter subunit is in the "Ready" or "Run" state.
	3-Quick start (non-latching)	The inverter subunit executes a quick start. The standard waiting times following a fault no longer apply.

9.4 Operating and monitoring the inverter via the touch panel

9.4.1 Introduction

You can enter all operating commands for the inverter via the touch panel in the cabinet door.

Furthermore, you can parameterize the SINVERT PVS inverter via the touch panel and check the inverter data.

The touch panel features intuitive menu prompting for this purpose.

9.4.2 Navigation structure of the touch panel

The figure below shows the navigation structure of the touch panel.

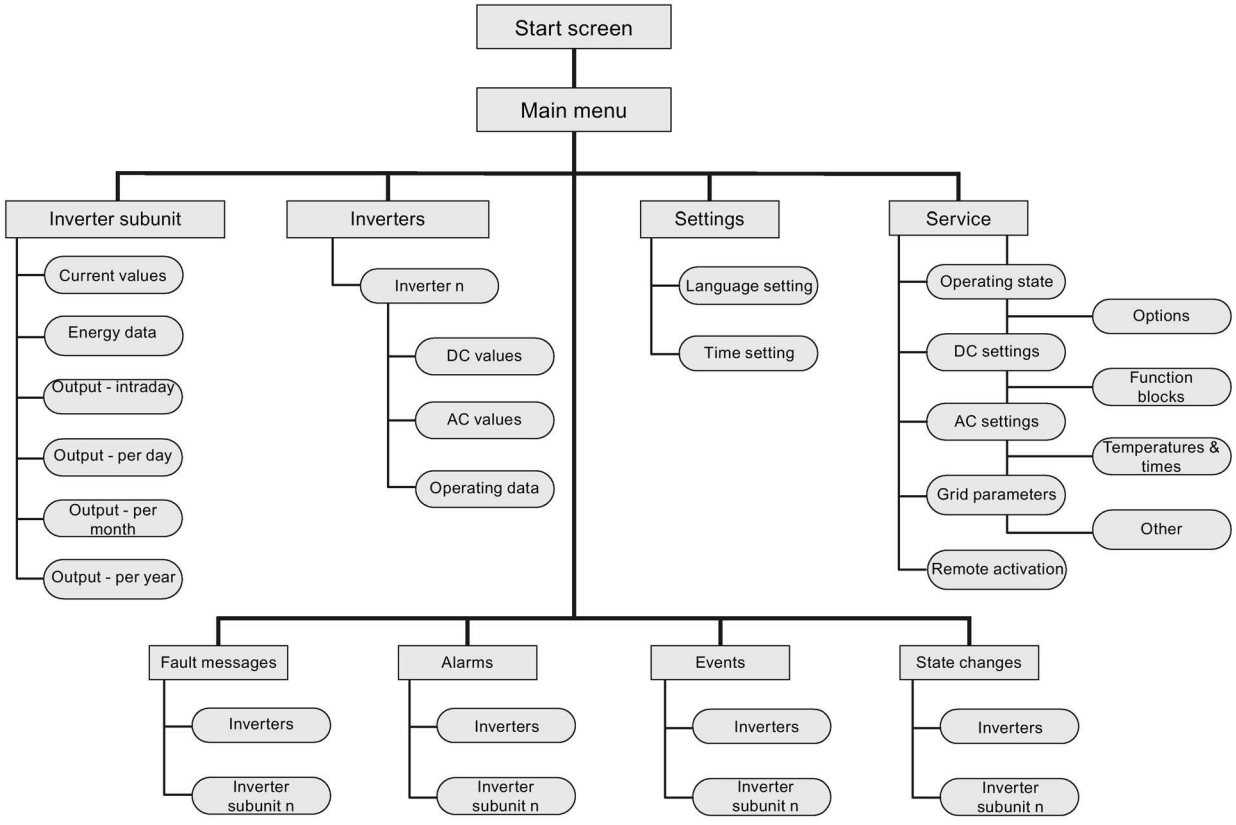


Figure 9-2 Navigation structure of the touch panel

9.4.3 Start window (status indicator)

After switching on the power supply, a language must first be selected. Then, the start window will appear with the status indicator.

Start window (status indicator)

The start window shows the operating data of the SINVERT PVS inverter:

- Current output
- Daily energy
- Total energy

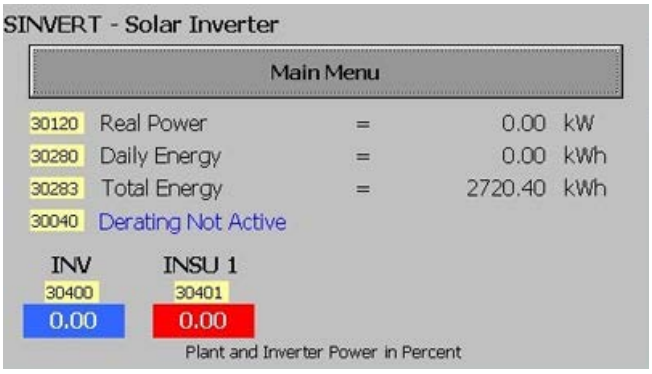


Figure 9-3 Start window of the touch panel

Color identification for readable/writable parameters

The parameters visible on the touch panel can be readable or writable.

- The numbers of readable parameters are set against a yellow background.
- The numbers of writable parameters are set against a green background.

Operating status display

The operating status of the inverter and the individual inverter subunits is indicated by the color in the corresponding box.
The meaning of the colors is shown in the table below.

Color	Meaning	
	Inverter (INV)	Inverter subunit (INSU 1/INSU 2 ...)
Blue	All inverter subunits are off.	Inverter subunit is off, no fault messages
Green	At least one inverter subunit feeding in	Inverter subunit feeding in
Yellow	Alarm message active at all inverter subunits; at least one inverter subunit feeding in	Alarm message active Inverter subunit feeding in
red	Fault message; all inverter subunits have been switched off.	Fault message; inverter subunit has been switched off

9.4.4 Main menu

Pressing the "Main Menu" button in the start window will take you to the main menu.

The main menu features buttons for accessing further menus.

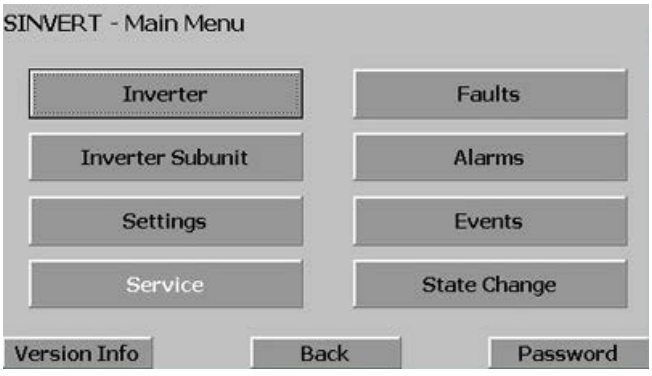


Figure 9-4 Touch panel - Main Menu

Access level and password

Some of the submenus and parameter changes are password-protected. This prevents unauthorized or inadvertent changing of device parameters.
The Service menu is reserved for service personnel.

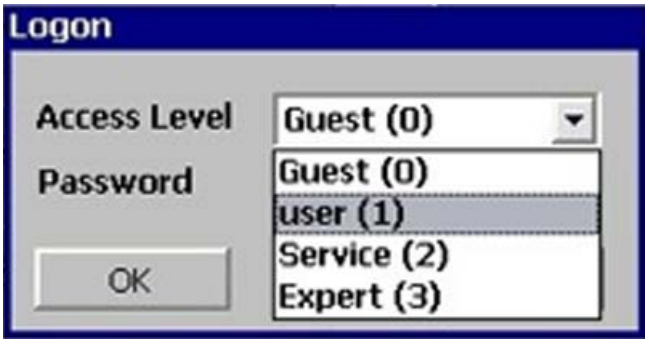
The following access levels are available to you:

Access level	Password	Authorization
Guest	without password	Read only access to parameters.
User	1111	Read access to all parameters and write access to some parameters

No password is required for guest access.

Procedure for entering the access level and password

1. In the main menu, press the "password" button .
   The login screen will appear.



2. Enter the desired access level and, if necessary, the associated password.
   - To avoid inadvertently changing data, use the access level "User" only if you want to make changes or check extended parameters.
   - Only change settings if you are sure of their meaning.

- If there is no input (in other words, no button is touched) for a period of 15 minutes, the system automatically changes to the lowest access level ("Guest"), regardless of the previously active access level.
- If a protected menu is called, the activated access level is checked. If the required access level is not active, the log on window also appears.

9.4.5 General information on working with the tool

The touch panel can be operated using the buttons in the individual windows.
In addition, the following instructions must be observed:

- Each touch panel window contains a "Back" button via which you can return to the next-higher level.
- If a menu item has more than one window, you can scroll up and down using additional buttons.
- Windows displaying current values or fault messages are freely accessible.
- Authorized personnel can also monitor and modify system settings, e.g. via the "Settings" and "Service" buttons in the main menu.

  The windows for editing system settings are provided with access protection, meaning that a password must be entered.

  Only authorized service personnel have access.

9.4.6 Service

The windows for editing system settings are provided with access protection. Only authorized service personnel have access. See also section Main menu (Page 143).

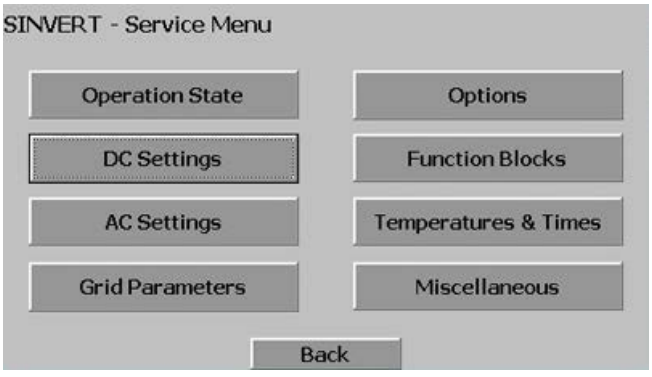


Figure 9-5 Touch panel - Service menu

The inverter can be parameterized by authorized personnel via the Service pages.

Examples:

- Changing to Debug mode by the service engineer
- Setting the parameters for the AC and DC side
- Defining the scope of functions by activating options or function blocks

9.5 Parameter list

9.5.1 Introduction

The lists below contain all the parameters that can be changed on the Service pages.

See also

SINVERT support (http://www.siemens.com/sinvert-support)

9.5.2 DC settings

Designation	Default	Min	Max	Description
Min. switch-on voltage	600 V	600 V	1000 V	Minimum voltage for switching on the inverter
Max. switch-on voltage	1000 V	600 V	1000 V	Maximum voltage for switching on the inverter
Min. voltage for switching in the contactors	500 V	500 V	500 V	Min. voltage for switching in the DC contactors
Max. voltage for switching in the contactors	1000 V	1000 V	1000 V	Max. voltage for switching in the DC contactors
Scaling value of the DC input voltage	1000 V	1000 V	1000 V	Scaling value of the DC input voltage
Min. DC voltage plausibility check	0 V	0 V	0 V	Minimum DC voltage for the plausibility check
Max. DC voltage plausibility check	1100 V	1100 V	1100 V	Maximum DC voltage for the plausibility check
Max. DC voltage load sharing control	750 V	750 V	750 V	Maximum DC voltage for load sharing control
Adjustment limit in % for load sharing control	1 %	1 %	1 %	Adjustment limit in % for load sharing control
Large search: Jump displacement	10 V	10 V	10 V	Jump displacement for the large MPP search
Large search: End of jump displacement time	10 V	10 V	10 V	End of jump displacement for the large MPP search
Small search: Jump displacement 1	4 V	4 V	4 V	Jump displacement 1 for the small MPP search
Small search: Jump displacement 2	2.5 V	2.5 V	2.5 V	Jump displacement 2 for the small MPP search
Return to shadowing detection	40 V	40 V	40 V	Return displacement for large MPP search if shadowing detection
Large search: End at percentage	95	95	95	Large MPP search: End at percentage
Search steps to return jump	5	5	5	Number of search steps with MPP search until return jump
Max. MPP current	1000 A	1 A	1000 A	Maximum MPP current
Min. DC current plausibility check	0 A	0 A	0 A	Minimum DC current for the plausibility check
Min. DC current plausibility check	1200 A	1200 A	1200 A	Maximum DC current for the plausibility check
Scaling value of the DC current	120 A	120 A	120 A	Scaling value of the DC current
Min. DC input current plausibility check	0 A	0 A	0 A	Minimum DC input current for the plausibility check
Max. DC input current plausibility check	400 A	400 A	400 A	Maximum DC input current for the plausibility check
Scaling value of the DC input current	400 A	400 A	400 A	Scaling value of the DC input current
Symmetry – current deviation	50 A	50 A	50 A	Symmetry – current deviation
Max. ground current plausibility check	0.8 A	0.8 A	0.8 A	Maximum ground current for the plausibility check
Scaling value of the ground current	0.1 A	0.1 A	0.1 A	Scaling value of the ground current

9.5.3 Grid parameters

Designation	Default	Min	Max
Overvoltage delay 1	100 ms	0	5 000 ms
Overvoltage delay 2	0 ms	0	5 000 ms
Undervoltage delay 1	1 500 ms	0	5 000 ms
Undervoltage delay 2	300 ms	0	5 000 ms
Overvoltage limit value 1	115.00 %	100 %	150 %
Overvoltage limit value 2	125.00 %	100 %	150 %
Undervoltage limit value 1	80.00 %	10 %	100 %
Undervoltage limit value 2	45.00 %	10 %	100 %
Overfrequency delay 1	100 ms	0	5 000 ms
Overfrequency delay 2	100 ms	0	5 000 ms
Underfrequency delay 1	100 ms	0	5 000 ms
Underfrequency delay 2	100 ms	0	5 000 ms
Overfrequency limit value 1	103.00 %	100 %	150 %
Overfrequency limit value 2	103.00 %	100 %	150 %
Underfrequency limit value 1	95.00 %	10 %	100 %
Underfrequency limit value 2	95.00 %	10 %	100 %
Activation FRT	ON (1)	0	1
Umin limit value 1 (FRT)	0.00 %	0	100 %
Time for Umin limit value 1 (FRT)	0.00 ms	0	10 000 ms
Umin limit value 2 (FRT)	5.00 %	0	100 %
Time for Umin limit value 2 (FRT)	200.00 ms	0	10 000 ms
Umin limit value 3 (FRT)	20.00 %	0	100 %
Time for Umin limit value 3 (FRT)	600.00 ms	0	10 000 ms
Umin limit value 4 (FRT)	50.00 %	0	100 %
Time for Umin limit value 4 (FRT)	1100.00 ms	0	10 000 ms
Umin limit value 5 (FRT)	90.00 %	0	100 %
Time for Umin limit value 5 (FRT)	1500.00 ms	0	10 000 ms
Umin limit value 6 (FRT)	90.00 %	0	100 %
Time for Umin limit value 6 (FRT)	1500.00 ms	0	10 000 ms
Umin limit value 7 (FRT)	90.00 %	0	100 %
Time for Umin limit value 7 (FRT)	1500.00 ms	0	10 000 ms
Umin limit value 8 (FRT)	90.00 %	0	100 %
Time for Umin limit value 8 (FRT)	1500.00 ms	0	10 000 ms
Umin limit value 9 (FRT)	90.00 %	0	100 %
Time for Umin limit value 9 (FRT)	1500.00 ms	0	10 000 ms
Umin limit value 10 (FRT)	90.00 %	0	100 %
Time for Umin limit value 10 (FRT)	1500.00 ms	0	10 000 ms

9.5.4 Temperatures and times

Note

In the case of changes, all times must be entered in ms using the numeric keypad.

Designation	Default	Min	Max
Fan run-on time	300000 ms = 5 min	0 ms	7200000 ms = 2 h
Fan run-on time following warning	900000 ms = 15 min	0 ms	7200000 ms = 2 h
Fan run-on time following fault	3600000 ms = 1 h	0 ms	7200000 ms = 2 h
Indicator light - slow flashing in normal mode	1000 ms = 1 s	0 ms	10000 ms = 10 s
Indicator light - fast flashing in normal mode	500 ms	0 ms	10000 ms = 10 s
Indicator light - slow flashing following warning	1000 ms = 1 s	0 ms	10000 ms = 10 s
Indicator light - fast flashing following warning	500 ms	0 ms	10000 ms = 10 s
Min. restart latency time INVS	60000 ms = 1 min	0 ms	300000 ms = 5 min
Max. restart latency time INVS	300000 ms = 5 min	0 ms	300000 ms = 5 min
Large search jump displacement time	2000 ms = 2 s	2000 ms = 2 s	2000 ms = 2 s
Large search end: Jump displacement time	1000 ms = 1 s	1000 ms = 1 s	1000 ms = 1 s
Small search: Jump displacement time	1500 ms = 1.5 s	1500 ms = 1.5 s	1500 ms = 1.5 s
Shadowing jump displacement time	4000 ms = 4 s	4000 ms = 4 s	4000 ms = 4 s
Shadowing restart time	4000 ms = 4 s	4000 ms = 4 s	4000 ms = 4 s
ISO contactor reset time	1800000 ms = 30 min	600000 ms = 10 min	3000000 ms = 50 min
ISO measuring time	600000 ms = 10 min	300000 ms = 5 min	900000 ms = 15 min
ISO switching latency time	60000 ms = 1 min	60000 ms = 1 min	180000 ms = 3 min
Contactor checkback time	3000 ms = 3 s	3000 ms = 3 s	3000 ms = 3 s
Transformer magnetization time 1	150 ms	150 ms	150 ms
Transformer magnetization time 2	150 ms	150 ms	150 ms
Symmetry - warning delay	30000 ms = 30 s	30000 ms = 30 s	30000 ms = 30 s
Opening delay MV circuit breaker	180000 ms = 3 min	180000 ms = 3 min	180000 ms = 3 min

Designation	Default	Min	Max
Fan switch-in temperature	55 °C	0 °C	60 °C
Fan temperature difference 1	2 °C	2 °C	2 °C
Fan temperature difference 2	4 °C	4 °C	4 °C
Fan temperature difference 3	6 °C	6 °C	6 °C
Fan temperature difference 4	8 °C	8 °C	8 °C
Fan temperature difference 5	10 °C	10 °C	10 °C
Warning temperature limit ALM supply air	70 °C	70 °C	70 °C
Warning temperature limit ALM heat sink	70 °C	70 °C	70 °C
Warning temperature limit container	60 °C	60 °C	60 °C
Fault temperature limit ALM supply air	80 °C	80 °C	80 °C
Fault temperature limit ALM heat sink	80 °C	80 °C	80 °C
Temperature limit for temperature derating	50.2 °C	50.2 °C	50.2 °C
Min. supply air temperature plausibility check	-50 °C	-50 °C	-50 °C
Max. supply air temperature plausibility check	100 °C	100 °C	100 °C

9.5.5 Miscellaneous

Designation	Default	Min	Max
Additional setpoint DC voltage	100 V	-200 V	150 V
Additional setpoint reactive power	0 var	0 var	0 var
Setpoint current limit ALM	-960 A	-1000 A	-1 A
Number of fan modules	1	1	50
Voltage divider factor (1000 V resistance)	1.429	0	5
Number of inverters in the inverter unit	1	1	4
DC contactors per inverter	3	3	3
Number of ISO DC contactor checks per day	3	0	5
Min. ISO resistance value plausibility check	0	0	0
Max. ISO resistance value plausibility check	11000	11000	11000
Operating mode of energy data calculation	0	0	0
Operating mode of the function block acoustic signal	2	2	2
Operating mode of the grid voltage control	0	0	0
cos φ setpoint	1	1	1
Min. cos φ setpoint	-0.2	-0.2	-0.2
Max. cos φ setpoint	0.2	0.2	0.2
Rated medium voltage	20 kV	20 kV	20 kV
Pulse value per counter pulse	1	1	1
Remote activation inverter 1	On	Off	On
Remote activation inverter 2	On	Off	On
Remote activation inverter 3	On	Off	On
Remote activation inverter 4	On	Off	On
Remote fast start inverter 1	Off	Off	On
Remote fast start inverter 2	Off	Off	On
Remote fast start inverter 3	Off	Off	On
Remote fast start inverter 4	Off	Off	On

9.6 Rapid stop function

The "rapid stop function" of the PVS inverter unit is used for fast shutdown of the AC grid in the event of faults and emergencies (e.g.: component malfunctions, excessively high temperatures, etc.).

Triggering the rapid stop function results in infeed mode abort.

⚠ WARNING

Hazardous voltages in the cabinet following actuation of rapid stop

The system is not isolated even after actuation of the rapid stop function. There are still hazardous voltages present in the cabinets.

Procedure and further measures

1. In the case of faults, the rapid stop switch installed at the suitable position must be actuated (see also Chapter Rapid stop function (Page 125)).
2. Shut down system (see Chapter Decommissioning the entire inverter (Page 134))
3. Eliminate the fault
4. Disengage rapid stop button
5. Execute commissioning (see Chapter Commissioning the inverter (Page 128))

Fault, alarm and system messages

10

10.1 Fault messages

Display of the fault messages

Fault messages comprising the following data are displayed on the touch panel:

- Time at which fault occurred
- Fault text
- Fault number
- Fault value
- Fault status

Fault messages of the inverter unit

The following table shows the faults of the inverter unit that are reported on the touch panel.

Table 10- 1 Fault messages of the inverter unit

Fault number	Fault source	Fault text	Fault acknowl-edgment
1	Rapid Stop	Rapid Stop triggered	Manual
21	Plausibility Check	Iso Resistor Value < Iso Resistor Value Min	Automatic [1)]
22	Plausibility Check	Iso Resistor Value > Iso Resistor Value Max	Automatic [1)]
23	Plausibility Check	Grounding Current < Grounding Current Min	Automatic [1)]
24	Plausibility Check	Grounding Current > Grounding Current Max	Automatic [1)]
31	Feedback Signal Monitoring	DC Grounding Switch feedback fault	Manual
41	Memory Check	Memory Fault - FBMemoryCheck	Manual
42	Memory Check	Memory Fault - FBGridMonitoring	Manual
43	Memory Check	Memory Fault - FBAntiIslanding	Manual
51	Fault Ride Through	Low Voltage Ride Through times error	Automatic [1)]
53	Fault Ride Through	Low Voltage Ride Through times error	Automatic [1)]

[1)] Automatic fault acknowledgment after 3 minutes.

Fault messages of the inverter subunit

The following table shows the faults of the inverter subunit that are reported on the touch panel.

Table 10- 2 Fault messages

Fault number	Fault source	Fault text	Fault acknowledgment
11	Grid Monitoring	Line to Neutral low voltage trip	Automatic [1]
12	Grid Monitoring	Line to Neutral high voltage trip	Automatic [1]
13	Grid Monitoring	Line to Line low voltage trip	Automatic [1]
14	Grid Monitoring	Line to Line high voltage trip	Automatic [1]
15	Grid Monitoring	Low Frequency trip	Automatic [1]
16	Grid Monitoring	High Frequency trip	Automatic [1]
17	Grid Monitoring	Line to Line low filter voltage trip	Automatic [1]
18	Grid Monitoring	Line to Line high filter voltage trip	Automatic [1]
19	Grid Monitoring	Open phase or current imbalance detected	Automatic [1]
20	Grid Monitoring	10 minute overvoltage grid fault	Automatic [1]
21	Chopper Test	Precharge resistor chopper test fault	Automatic [1]
32	Peripheral Faults	Reactor temperature fault	Automatic [2]
33	Peripheral Faults	Miniature circuit breaker blown	Manual
34	Peripheral Faults	DC precharge resistor overtemperature	Automatic [1]
41	Plausibility Check	DC Link Current < DC Link Current Min	Automatic [1]
42	Plausibility Check	DC Link Current > DC Link Current Max	Automatic [1]
43	Plausibility Check	DC Current Input x < DC Current InputMin	Automatic [1]
44	Plausibility Check	DC Current Input x > DC Current InputMax	Automatic [1]
45	Plausibility Check	AC Current Phase x < AC Current PhaseMin	Automatic [1]
46	Plausibility Check	AC Current Phase x > AC Current PhaseMax	Automatic [1]
47	Plausibility Check	Supply Air Temp < Supply Air Temp Min	Automatic [1]
48	Plausibility Check	Supply Air Temp > Supply Air Temp Max	Automatic [1]
49	Plausibility Check	DC Input Currents > DC Link Current	Automatic [1]
50	Plausibility Check	DC Link Current > DC Input Currents	Automatic [1]
51	Plausibility Check	DC Voltage Input x < DC Voltage InputMin	Automatic [1]
52	Plausibility Check	DC Voltage Input x > DC Voltage InputMax	Automatic [1]
61	Feedback Monitoring	AC contactor feedback fault	Manual
62	Feedback Monitoring	DC precharge resistor contactor 1	Manual
63	Feedback Monitoring	DC precharge resistor contactor 2	Manual
64	Feedback Monitoring	DC precharge resistor contactor 3	Manual
65	Feedback Monitoring	Enable Pulse Feedback Fault	Automatic [1]
71	Sinamics Monitoring	SINAMICS power stack fault	Automatic [1]
72	Sinamics Monitoring	SINAMICS Control Unit fault	Automatic [1]

[1] Automatic fault acknowledgment after 3 minutes.

[2] Automatic fault acknowledgment after 15 minutes.

10.2 Fault correction

Fault messages for the inverter unit

In this section, you will find all fault messages for the inverter unit and their descriptions, possible causes and possible corrective measures. This data is made available in the form of a table for each fault message:

Fault number 1 – RapidStop – Rapid Stop triggered	
Description	Control Unit records a request for rapid stop of the inverter.
Possible causes	• Wire break of the rapid stop signal • Rapid stop switch actuated
Measures	• Replace the broken wire if there is a wire break and acknowledge the fault. • After clarification of the reason for actuating the rapid stop switch, release it and acknowledge the fault manually on the inverter.

Fault number 21 – Plausibility Check – Iso Resistor Value < Iso Resistor Value Min	
Description	Control Unit records a negative resistance of the isolation measuring device.
Possible causes	Incorrect connection of the isolation measuring device
Measures	Check the wiring of the isolation measuring device.

Fault number 22 – Plausibility Check – Iso Resistor Value > Iso Resistor Value Max	
Description	Control Unit records an excessively high resistance of the isolation measuring device.
Possible causes	Incorrect connection of the isolation measuring device
Measures	Check the wiring of the isolation measuring device.

Fault number 23 – Plausibility Check – Grounding Current < Grounding Current Min	
Description	Control Unit records an excessively low grounding current.
Possible causes	Incorrect connection of the current transducer for measuring the grounding current
Measures	Check the wiring of the current transducer for measuring the grounding current.

Fault number 24 – Plausibility Check – Grounding Current > Grounding Current Max	
Description	Control Unit records an excessively high grounding current.
Possible causes	Incorrect connection of the current transducer for measuring the grounding current
Measures	Check the wiring of the current transducer for measuring the grounding current.

Fault number 31 – Feedback Signal Monitoring – DC Grounding Switch feedback fault	
Description	Control Unit records a checkback signal fault of the DC grounding contactor.
Possible causes	• The contacts of the contactor are stuck • The coil of the contactor is defective • Wire break on the cable for the checkback signal of the contactor
Measures	• Check the contactor for a defect. • Check the wiring of the checkback signal of the contactor.

Fault number 41 – Memory Check - Memory Fault - FBMemoryCheck	
Description	Control Unit records an internal memory fault of the Control Unit in the block FBMemoryCheck.
Possible causes	Internal fault
Measures	Contact Siemens Service.

Fault number 42 – Memory Check - Memory Fault - FBGrid Monitoring	
Description	Control Unit records an internal memory fault of the Control Unit in the block FBGridMonitoring.
Possible causes	Internal faults
Measures	Contact Siemens Service.

Fault number 43 – Memory Check - Memory Fault - FBAntiIslanding	
Description	Control Unit records an internal memory fault of the Control Unit in the block FBAntiIslanding.
Possible causes	Internal faults
Measures	Contact Siemens Service.

Fault number 51 – Fault Ride Through - Low Voltage Ride Through times error	
Description	The Control Unit has detected that the times of the LVRT configuration have been set incorrectly. (Time x is less than time x-1)
Possible causes	Incorrect setting of at least one time of the LVRT configuration
Measures	Change the time parameterization of the LVRT configuration

Fault number 53 – Fault Ride Through - High Voltage Ride Through times error	
Description	The Control Unit has detected that the times of the HVRT configuration have been set incorrectly. (Time x is less than time x-1)
Possible causes	Incorrect setting of at least one time of the HVRT configuration
Measures	Change the time parameterization of the HVRT configuration

Fault messages for the inverter subunit

In this section, you will find all fault messages for the inverter subunit and their descriptions, possible causes and possible corrective measures. This data is made available in the form of a table for each fault message:

Fault number 11 - Grid Monitoring - Line to Neutral low voltage trip	
Description	Control Unit records an excessively low phase-to-neutral voltage (P2N) at the AC output of the inverter.
Possible causes	• Power failure on at least one of the system phases • System undervoltage on at least one of the system phases • Circuit breaker at the AC output of the inverter has tripped • Neutral conductor of the Sentron PAC4200 missing • Incorrect parameter settings
Measures	Proceed depending on the fault cause: • Switch the circuit breakers back on after clarification of the cause of the fault. • Connect the neutral conductor of the SENTRON PAC3200. • If necessary, adapt the parameter settings.

Fault number 12 - Grid Monitoring - Line to Neutral high voltage trip	
Description	Control Unit records an excessively high phase-to-neutral voltage (P2N) at the AC output of the inverter.
Possible causes	• System overvoltage on at least one of the system phases • Incorrect parameter settings
Measures	If necessary, adapt the parameter settings.

Fault number 13 - Grid Monitoring - Line to Line low voltage trip	
Description	Control Unit records an excessively low phase-phase voltage (P2P) at the AC output of the inverter.
Possible causes	• Power failure on at least one of the system phases • System undervoltage on at least one of the system phases • Circuit breaker at the AC output of the inverter has tripped • Incorrect parameter settings
Measures	Proceed depending on the fault cause • Switch the circuit breakers back on after clarification of the cause of the fault. • If necessary, adapt the parameter settings.

Fault number 14 - Grid Monitoring - Line to Line high voltage trip	
Description	Control Unit records an excessively high phase-phase voltage at the AC output of the inverter.
Possible causes	System overvoltage on at least one of the system phases
Measures	If necessary, adapt the parameter settings.

Fault number 15 - Grid Monitoring – Low Frequency trip	
Description	Control Unit records an excessively low grid frequency at the AC output of the inverter.
Possible causes	• Grid fault of the power utility • Circuit breaker at the AC output of the inverter has tripped • Incorrect parameter settings
Measures	Proceed depending on the fault cause • Switch the circuit breakers back on after clarification of the cause of the fault. • If necessary, adapt the parameter settings.

Fault number 16 - Grid Monitoring - High Frequency trip	
Description	Control Unit records an excessively high grid frequency at the AC output of the inverter.
Possible causes	• Grid fault of the power utility • Incorrect parameter settings
Measures	If necessary, adapt the parameter settings.

Fault number 17 - Grid Monitoring - Line to Line low filter voltage trip	
Description	Control Unit records an excessively low phase-phase voltage at the AC output filter of the inverter.
Possible causes	• Power failure on at least one of the system phases • System undervoltage on at least one of the system phases • Circuit breaker at the AC output of the inverter has tripped • Incorrect parameter settings
Measures	Proceed depending on the fault cause • Switch the circuit breakers back on after clarification of the cause of the fault. • If necessary, adapt the parameter settings.

Fault number 18 - Grid Monitoring - Line to Line high filter voltage trip	
Description	Control Unit records an excessively high phase-phase voltage at the AC output filter of the inverter.
Possible causes	• System overvoltage on at least one of the system phases • Incorrect parameter settings
Measures	If necessary, adapt the parameter settings.

Fault number 19 - Grid Monitoring – Open phase condition detected	
Description	Control Unit records a single-phase grid failure at the AC output of the inverter.
Possible causes	• Grid fault of the power utility • Circuit breaker at the AC output of the inverter has tripped
Measures	Switch the circuit breakers back on after clarification of the cause of the fault.

Fault number 20 - Grid Monitoring – 10 minute overvoltage grid fault	
Description	Control Unit records an excessively high 10-minute average value of the AC voltage.
Possible causes	• Grid fault of the power utility • Incorrect parameter settings
Measures	If necessary, adapt the parameter settings.

Fault number 21 - Chopper Test – Precharge resistor chopper test fault	
Description	Control Unit records a request to shut down the inverter due to an over-temperature fault at the DC pre-charging resistors for option D61 (1000 V option).
Possible causes	• Wire break of the temperature fault signal • Overtemperature at the temperature sensor
Measures	1. Replace the broken wire if there is a wire break and acknowledge the fault. 2. Contact Siemens Service.

Fault number 32 – Peripheral Faults – Reactor Temperature Fault	
Description	Control Unit records a temperature fault of the reactor (T ≥ 180 °C).
Possible causes	• Wire break of the overtemperature signal • Reactor fans defective • Ventilation inlet of the reactor covered
Measures	Proceed depending on the fault cause • Replace the broken wire if there is a wire break and acknowledge the fault. • Replace the reactor fans. • Clear the ventilation inlet of the inverter.

Fault number 33 – Peripheral Faults – Miniature Circuit Breaker Blown	
Description	Control Unit records that at least one miniature circuit breaker has tripped.
Possible causes	• Wire break of a miniature circuit breaker signal • At least one miniature circuit breaker has tripped
Measures	Proceed depending on the fault cause • Replace the broken wire if there is a wire break and acknowledge the fault. • Clarify why the miniature circuit breaker has tripped and acknowledge the fault.

Fault number 34 – Peripheral Faults – DC precharge resistor overtemperature	
Description	Control Unit records a temperature fault of the precharge resistors (T ≥ 200 °C) of option D61 (1000 V option).
Possible causes	• Wire break of the overtemperature signal • Overtemperature of the precharge resistors when switching in the inverter
Measures	Proceed depending on the fault cause: • Replace the broken wire if there is a wire break and acknowledge the fault. • Contact Siemens Service.

Fault number 41 – Plausibility Check – DC Link Current < DC Link Current Min	
Description	Control Unit records an excessively low DC link current.
Possible causes	Short-circuit in the PV field
Measures	Check for a short-circuit in the PV field

Fault number 42 – Plausibility Check – DC Link Current > DC Link Current Max	
Description	Control Unit records an excessively high DC link current.
Possible causes	The photovoltaic modules have been incorrectly interconnected
Measures	Check the configuration of the PV field.

Fault number 43 – Plausibility Check – DC Current Input x < DC Current Input Min	
Description	Control Unit records an excessively low DC input current at a DC input.
Possible causes	Short-circuit in the PV field
Measures	Check for a short-circuit in the PV field

Fault number 44 – Plausibility Check – DC Current Input x > DC Current Input Max	
Description	Control Unit records an excessively high DC input current at a DC input.
Possible causes	Incorrect interconnection of the photovoltaic modules
Measures	Check the configuration of the PV field.

Fault number 45 – Plausibility Check – AC Current Phase x < AC Current PhaseMin	
Description	Control Unit records an excessively low AC phase current.
Possible causes	Incorrect connection of the current transducers at the AC output of the inverter
Measures	Check the wiring of the current transducers.

Fault number 46 – Plausibility Check – AC Current Phase x > AC Current PhaseMax	
Description	Control Unit records an excessively high AC phase current.
Possible causes	Short-circuit on the AC output side of the inverter or in the supply system
Measures	Check the configuration of the circuit breaker at the AC output of the inverter.

Fault number 47 – Plausibility Check – Supply Air Temp < Supply Air Temp Min	
Description	Control Unit records an excessively low supply air temperature.
Possible causes	• Incorrect connection of the temperature sensor for the supply air temperature of the inverter • Supply air temperature outside tolerance
Measures	Check the wiring of the temperature sensor for measuring the supply air temperature.

Fault number 48 – Plausibility Check – Supply Air Temp > Supply Air Temp Max	
Description	Control Unit records an excessively high supply air temperature.
Possible causes	• Incorrect connection of the temperature sensor for the supply air temperature of the inverter • Supply air temperature outside tolerance
Measures	Check the wiring of the temperature sensor for measuring the supply air temperature.

Fault number 49 – Plausibility Check – DC Input Currents > DC Link Current	
Description	The sum of the input currents for all three inputs according to measurement is greater than the DC link current.
Possible causes	Measuring device is defective
Measures	Contact Siemens Service.

Fault number 50 – Plausibility Check – DC Link Current > DC Input Currents	
Description	The sum of the currents for all three inputs according to measurement is less than the DC link current.
Possible causes	Measuring device is defective
Measures	Contact Siemens Service.

Fault number 51 – Plausibility Check – DC Voltage Input x < DC Voltage InputMin	
Description	Control Unit records an excessively low DC input voltage at a DC input.
Possible causes	• The PV field has been connected with reverse polarity on at least one input • Incorrect connection of the option DC input voltage measurement
Measures	Proceed depending on the fault cause • Check the correct connection of the PV field at the inverter input. • Check the wiring of the DC input voltage measurement.

Fault number 52 – Plausibility Check – DC Voltage Input x > DC Voltage InputMax	
Description	Control Unit records an excessively high DC input voltage at an input.
Possible causes	• Incorrect PV field configuration • Incorrect connection of the option DC input voltage measurement
Measures	Proceed depending on the fault cause: • Check the interconnection of the PV modules and strings. • Check the wiring of the DC input voltage measurement.

Fault number 61 – Feedback Monitoring – AC Contactor feedback fault	
Description	Control Unit records a checkback signal fault of the AC contactor.
Possible causes	• The contacts of the AC contactor are stuck • The coil of the AC contactor is defective • Wire break on the cable for the checkback signal of the AC contactor
Measures	• Check the AC contactor for a defect. • Check the wiring of the checkback signal of the AC contactor.

Fault number 62 – Feedback Monitoring – DC precharge resistor contactor 1	
Description	Control Unit records a checkback signal fault of DC precharge resistor contactor 1.
Possible causes	• The contacts of the contactor are stuck • The coil of the contactor is defective • Wire break on the cable for the checkback signal of the contactor
Measures	• Check the contactor for a defect. • Check the wiring of the checkback signal of the contactor.

Fault number 63 – Feedback Monitoring – DC precharge resistor contactor 2	
Description	Control Unit records a checkback signal fault of DC precharge resistor contactor 2.
Possible causes	• The contacts of the contactor are stuck • The coil of the contactor is defective • Wire break on the cable for the checkback signal of the contactor
Measures	• Check the contactor for a defect. • Check the wiring of the checkback signal of the contactor.

Fault number 64 – Feedback Monitoring – DC precharge resistor contactor 3	
Description	Control Unit records a checkback signal fault of DC precharge resistor contactor 3.
Possible causes	• The contacts of the contactor are stuck • The coil of the contactor is defective • Wire break on the cable for the checkback signal of the contactor
Measures	• Check the contactor for a defect. • Check the wiring of the checkback signal of the contactor.

Fault number 65 – Feedback Monitoring – Enable Pulse Feedback Fault	
Description	The Control Unit has detected that the external enable of the power block has been controlled incorrectly.
Possible causes	• Defective control relay • 24 V power supply is faulty • Control cables or signal cables are faulty
Measures	• Check control relay (-K107 in DC cabinet section) • Check 24 V power supply and if necessary readjust to 26 V • Check control cables and signal cables and replace if necessary

Fault number 71 – Sinamics Monitoring – Sinamics power stack fault	
Description	Control Unit records a fault of the power unit or the Control Unit.
Possible causes	Internal fault
Measures	Contact Siemens Service and specify the fault value.

Fault number 72 – Sinamics Monitoring – Sinamics Control Unit fault	
Description	The Control Unit has failed.
Possible causes	---
Measures	Contact Siemens Service and specify the fault value.

10.3 Alarms

Display of the alarms

Alarms comprising the following data are displayed on the touch panel:

- Time at which alarm occurred
- Alarm text
- Alarm status

Inverter unit alarm messages

The following table shows the alarms of the inverter unit that are reported on the touch panel.

Table 10- 3 Inverter unit alarm messages

Alarm number	Alarm source	Alarm text
1	Date and time	Date and time are set to factory settings
11	Isolation routine	Isolation alarm detected
12	Isolation routine	Isolation fault detected
21	PV field grounding module	PV field grounding current too high

Alarm messages of the inverter subunit

The following table shows the alarms of the inverter subunit that are reported on the touch panel.

Table 10- 4 Alarm messages of the inverter subunit

Alarm number	Alarm source	Alarm text
1	Surge Protection	Change the surge protection AC side
2	Surge Protection	Change the surge protection DC side
11	Reactor Module	Reactor temperature warning
21	Symmetry Check Module	DC Input 1 symmetry check warning
22	Symmetry Check Module	DC Input 2 symmetry check warning
23	Symmetry Check Module	DC Input 3 symmetry check warning
31	DC Contactor	DC Contactor 1 feedback fault
32	DC Contactor	DC Contactor 2 feedback fault
33	DC Contactor	DC Contactor 3 feedback fault
41	Circuit Breakers	Miniature circuit breaker blown
51	Fault Ride Through	Low Voltage Ride Through active
53	Fault Ride Through	High Voltage Ride Through active

10.4 Correction of the alarms

Alarm messages for the inverter unit

In this section, you will find all alarms for the inverter unit and their descriptions, possible causes and possible corrective measures. This data is made available in the form of a table for each alarm message:

Alarm number 11 - Isolation Routine - Isolation warning detected	
Description	The isolation of the PV modules with respect to ground is lower than the 1st limit.
Possible causes	• Moisture • Fault in the PV field
Measures	Observe whether the alarm also occurs in dry weather. If this is the case, proceed as follows: • Check the PV field. • Contact Siemens Service.

Alarm number 12 - Isolation Routine - Isolation fault detected	
Description	The isolation of the PV modules with respect to ground is lower than the 2nd limit.
Possible causes	• Moisture • Fault in the PV field
Measures	Observe whether the alarm also occurs in dry weather. If this is the case, proceed as follows: • Check the PV field. • Contact Siemens Service.

Alarm number 21 - PV Field Grounding Module - PV field grounding current too high	
Description	The leakage current of the modules is too high.
Possible causes	Ground fault in the PV field
Measures	• Check the PV field for ground fault. • Contact Siemens Service.

Alarm messages for the inverter subunit

In this section, you will find all alarm messages for the inverter subunit and their descriptions, possible causes and possible corrective measures. This data is made available in the form of a table for each alarm message:

Alarm number 1 - Surge Protection - Change the surge protection AC side	
Description	The overvoltage protection on the AC side has tripped.
Possible causes	Overvoltage at the AC output of the inverter
Measures	Contact Siemens Service.

Alarm number 2 - Surge Protection - Change the surge protection DC side	
Description	The overvoltage protection on the DC side has tripped.
Possible causes	Overvoltage at the DC output of the inverter
Measures	Contact Siemens Service.

Alarm number 11 - Reactor Module - Reactor temperature warning	
Description	The reactor temperature exceeds the value expected for the current operating mode.
Possible causes	• Fan failure • Reactor is defective
Measures	Contact Siemens Service.

Alarm number 21 / 22 / 23 - Symmetry Check Module - DC Input 1 / 2 / 3 symmetry check warning	
Description	The Control Unit detects asymmetry in the DC input current to a DC input.
Possible causes	• PV field is damaged • Sensor for current input measurement is defective
Measures	• Check the PV field. • Contact Siemens Service.

Alarm number 31 / 32 / 33- DC Contactor - DC Contactor 1 / 2 / 3 feedback fault	
Description	The DC contactor does not provide any feedback.
Possible causes	• DC contactor of the inverter subunit 1, 2 or 3 is defective • Broken cable
Measures	Check the DC contactor for possible faults. Possible faults are: • Coil is defective • Contacts are worn • Wire break

Alarm number 41 - Circuit Breakers - Miniature circuit breaker blown	
Description	Control Unit records that at least one miniature circuit breaker has tripped.
Possible causes	• Short circuit in the inverter subunit • Overload in the inverter subunit
Measures	• Check the miniature circuit breakers. Perform the following checks: – Optical check – Check the inverter subunit for short circuit • Contact Siemens Service.

Alarm number 51 – Fault Ride Through - Low Voltage Ride Through active	
Description	The grid voltage of the inverter subunit is less than the parameterized start value for LVRT.
Possible causes	Grid undervoltage / brief grid interruption
Measures	—

Alarm number 53 – Fault Ride Through - High Voltage Ride Through active	
Description	The grid voltage of the inverter subunit is higher than the parameterized start value for HVRT.
Possible causes	Grid overvoltage / grid voltage peak
Measures	—

10.5 Event messages

Displaying event messages

Event messages comprising the following data are displayed on the touch panel:

- Event time (date and time)
- Event text

Up to 20 event messages can be tracked on the touch panel (storage of 35 event messages).

Event messages of the inverter unit

The following table shows the event messages of the inverter unit that are reported on the touch panel.

Table 10- 5 Event messages of the inverter unit

Event number	Event source	Event text
1	MPP Tracker	MPPT – MPP tracker stopped
2	MPP Tracker	MPPT – Big tracking started
3	MPP Tracker	MPPT – MPP reached
4	MPP Tracker	MPPT – minimum voltage limit reached
5	MPP Tracker	MPPT – maximum voltage limit reached
11	Inverter	Inverter stopped – Insufficient power
21	Fault Manager	No faults in system
22	Fault Manager	Fault detected – Automatic reset
23	Fault Manager	Fault detected – No automatic reset

Event messages of the inverter subunit

The following table shows the event messages of the inverter subunit that are reported on the touch panel.

Table 10- 6 Event messages of the inverter subunit

Event number	Event source	Event text
1	Mini panel	Key switch activated
2	Mini Panel	Key switch for fast start activated
3	Mini Panel	Key switch deactivated
11	Fault Manager	No faults in system
12	Fault Manager	Fault detected – Automatic reset
13	Fault Manager	Fault detected – No automatic reset
21	Contactors	DC contactor 1 closed
22	Contactors	DC contactor 1 opened
23	Contactors	DC contactor 2 closed
24	Contactors	DC contactor 2 opened
25	Contactors	DC contactor 3 closed
26	Contactors	DC contactor 3 opened
27	Contactors	DC precharge contactor 1 closed
28	Contactors	DC precharge contactor 1 opened
29	Contactors	DC precharge contactor 2 closed
30	Contactors	DC precharge contactor 2 opened
31	Contactors	DC precharge contactor 3 closed
32	Contactors	DC precharge contactor 3 opened
33	Contactors	AC contactor closed
34	Contactors	AC contactor opened
35	Contactors	DC precharge contactor Rp closed
36	Contactors	DC precharge contactor Rp opened
41	Fans	Fans grade 1 activated
42	Fans	Fans grade 1 deactivated
43	Fans	Fans grade 2 activated
44	Fans	Fans grade 2 deactivated

Event description for the inverter unit

In this section, you will find all event messages for the inverter unit and their descriptions. This data is made available in the form of a table for each event message:

Event number 1 – MPP Tracker – MPPT--MPP tracker stopped	
Event	MPPT – MPP tracker stopped
Description	MPP tracking was used.

Event number 2 – MPP Tracker – MPPT--Big tracking started	
Event	MPPT – Big tracking started
Description	MPP tracking started big tracking to find the optimum maximum power point.

Event number 3 – MPP Tracker – MPPT--MPP reached	
Event	MPPT – MPP reached
Description	The optimum operating point has been reached.

Event number 4 – MPP Tracker – MPPT--minimum voltage limit reached	
Event	MPPT – lower voltage limit reached
Description	The MPP tracker reached the minimum voltage level.

Event number 5 – MPP Tracker – MPPT--maximum voltage limit reached	
Event	MPPT – upper voltage limit reached
Description	The MPP tracker reached the maximum voltage level.

Event number 11 – Inverter – Inverter stopped--insufficient power	
Event	Inverter stopped – insufficient power
Description	The inverter switched off because insufficient energy was generated to cover the intrinsic needs of the converter.

Event number 21 – Fault Manager – No faults in system	
Event	No faults in the system
Description	The inverter unit was operating at the ideal level and fault-free.

Event number 22 – Fault Manager – Fault detected--Automatic reset	
Event	Fault detected – Automatic reset
Description	The Fault Manager detected a fault in the inverter unit that results in an automatic acknowledgment.

Event number 23 – Fault Manager – Fault detected--No automatic reset	
Event	Fault detected – No automatic reset
Description	The fault Manager detected a fault in the inverter unit that does not result in an automatic acknowledgment. This must be acknowledged manually.

Event description for the inverter subunit

In this section, you will find all event messages for the inverter subunit and their descriptions. This data is made available in the form of a table individually for each event message.

Event number 1 – Mini Panel – Key switch activated	
Event	Keyswitch activated
Description	The keyswitch of the inverter unit has been activated and the device has thus been started up.

Event number 2 – Mini Panel – Key switch for fast start activated	
Event	Keyswitch for fast start activated
Description	The keyswitch has been brought to the position for a fast start of the inverter unit.

Event number 3 – Mini Panel – Key switch deactivated	
Event	Keyswitch deactivated
Description	The keyswitch of the inverter unit has been deactivated and the device has thus been stopped.

Event number 11 – Fault Manager – No faults in system	
Event	No faults in the system
Description	The inverter subunit was operating at the ideal level and fault-free.

Event number 12 – Fault Manager – Fault detected--Automatic reset	
Event	Fault detected – Automatic reset
Description	The Fault Manager detected a fault in the inverter unit that results in an automatic acknowledgment.

Event number 13 – Fault Manager – Fault detected--No automatic reset	
Event	Fault detected – No automatic reset
Description	The Fault Manager detected a fault in the inverter subunit that does not result in an automatic acknowledgment. This must be acknowledged manually.

Event number 21 – Contactors – DC contactor 1 closed	
Event	DC contactor 1 closed
Description	DC contactor 1 has been closed. The first DC input of the inverter subunit has been started up.

Event number 22 – Contactors – DC contactor 1 opened	
Event	DC contactor 1 opened
Description	DC contactor 1 has been opened. The first DC input of the inverter subunit has been switched off.

Event number 23 – Contactors – DC contactor 2 closed	
Event	DC contactor 2 closed
Description	DC contactor 2 has been closed. The second DC input of the inverter subunit has been started up.

Event number 24 – Contactors – DC contactor 2 opened	
Event	DC contactor 2 opened
Description	DC contactor 2 has been opened. The second DC input of the inverter subunit has been switched off.

Event number 25 – Contactors – DC contactor 3 closed	
Event	DC contactor 3 closed
Description	DC contactor 3 has been closed. The third DC input of the inverter subunit has been started up.

Event number 26 – Contactors – DC contactor 3 opened	
Event	DC contactor 3 opened
Description	DC contactor 3 has been opened. The third DC input of the inverter subunit has been switched off.

Event number 27 – Contactors – DC precharge contactor 1 closed	
Event	DC precharge contactor 1 closed
Description	DC precharge contactor 1 has been closed.

Event number 28 – Contactors – DC precharge contactor 1 opened	
Event	DC precharge contactor 1 opened
Description	DC precharge contactor 1 has been opened.

Event number 29 – Contactors – DC precharge contactor 2 closed	
Event	DC precharge contactor 2 closed
Description	DC precharge contactor 2 has been closed.

Event number 30 – Contactors – DC precharge contactor 2 opened	
Event	DC precharge contactor 2 opened.
Description	DC precharge contactor 2 has been opened.

Event number 31 – Contactors – DC precharge contactor 3 closed	
Event	DC precharge contactor 3 closed
Description	DC precharge contactor 3 has been closed.

Event number 32 – Contactors – DC precharge contactor 3 opened	
Event	DC precharge contactor 3 opened
Description	DC precharge contactor 3 has been opened.

Event number 33 – Contactors – AC contactor closed	
Event	AC contactor closed
Description	AC contactor has been closed. The inverter subunit is feeding energy into the grid.

Event number 34 – Contactors – AC contactor opened	
Event	AC contactor opened
Description	AC contactor has been opened. The inverter subunit is not feeding energy into the grid.

Event number 35 – Contactors – DC precharge contactor Rp closed	
Event	DC precharge contactor Rp closed
Description	DC precharge contactor Rp has been closed.

Event number 36 – Contactors – DC precharge contactor Rp opened	
Event	DC precharge contactor Rp opened
Description	DC precharge contactor Rp has been opened.

Event number 41 – Fans – Fans grade 1 activated	
Event	Fans grade 1 activated
Description	Fans grade 1 have been activated.

Event number 42 – Fans – Fans grade 1 deactivated	
Event	Fans grade 1 deactivated
Description	Fans grade 1 have been deactivated.

Event number 43 – Fans – Fans grade 2 activated	
Event	Fans grade 2 activated
Description	Fans grade 2 have been activated.

Event number 44 – Fans – Fans grade 2 deactivated	
Event	Fans grade 2 deactivated
Description	Fans grade 2 have been deactivated.

10.6 Messages of the operator panel

The indicator lights on the operator panel in the cabinet door signal the following information:

Table 10- 7 Information signaled by the operator panel indicator lights

Operator control	State	Description
Green indicator light "Run"	Not illuminated	1. Check the grid voltage. 2. Please contact Technical Support.
	Flashing slowly, 1 s cycle	Move the key-operated switch to position "2".
	Flashing fast, 250 ms cycle	No action necessary. Note: If no fault signal is active and the inverter does not switch to the "Run" state despite adequate insolation, please check the following: • Check the DC-side fuses. • Check the polarity of the PV array connection is correct.
	Illuminated steadily	No action necessary.
Yellow indicator light "Fault"	Not illuminated	No action necessary.
	Flashing slowly, 1 s cycle	A warning is active. The inverter remains in operation, but maintenance is required.
	Flashing fast, 250 ms cycle	No action necessary because the inverter will automatically acknowledge the fault after a specific period.
	Illuminated steadily	A fault which requires manual acknowledgement is active.

Maintenance 11

11.1 Servicing

The term "servicing" refers to any measure which restores the control cabinet to a fully functional operating state.

Replaceable components

You are allowed to replace the following components.

- Fuses
- Overvoltage arresters
- Reactor fans
- Inverter fans

11.2 Maintenance

The term "maintenance" refers to any measure which maintains the control cabinet in a fully functional operating state.

Maintenance work

You must carry out the following maintenance work at the indicated intervals to ensure the long-term operability of the control cabinet.

Table 11- 1 Maintenance concept

Maintenance work	Interval
Clean the inside of the cabinet.	At least 1 x per year
Replace surge arrester if inspection window is on "red"	Visual check 1 x per year
Replace the cabinet fans.	Every 15 years
Replace inverter fans. (service life: 50000 hours)	Every 13 years

Note

Maintenance intervals

The actual maintenance intervals depend on the cabinet's environment and operating condition.

11.3 Cleaning the inside of the cabinet

Requirements

- The inverter has been properly shut down. See Chapter Decommissioning the entire inverter (Page 134).
- A voltage tester is available to check that the cabinet is de-energized.
- A cabinet key is available.
- Cleaning brush and vacuum cleaner are available.
- A supply of oil-free compressed air up to maximum 1 bar is available.

Clean the cabinet

1. Check that the cabinet is de-energized.
2. Use the brush and vacuum cleaner to remove dust deposits on easily accessible components.
3. Use dry compressed air at a pressure of maximum 1 bar to clean dust deposits off less easily accessible components.

Clean the fans in the AC cabinet

1. Loosen the four screws that secure the fan module in the control cabinet.
2. Carefully remove the fan unit.
3. Loosen the plug-in connections.
4. Remove the fan unit and clean the fans.
5. Replace the fan unit and connect the plug-in contacts.
6. Screw the fan unit tight in the AC cabinet with the four screws.

Close the cabinet and restart it

1. Close the cabinet door.
2. Energize the feeders at the DC and AC inputs again.
3. Start up the control cabinet again.
   See Chapter Commissioning the inverter (Page 128).

Documentation

Document the results in the maintenance log.

Inverter subunits

Proceed in the same way for further inverter subunits.

11.4 Replacing the reactor fan

Requirements

- The control cabinet has been properly shut down.

  See Chapter Decommissioning the entire inverter (Page 134).
- The feeders at the DC and AC inputs are de-energized.
- A voltage tester is available to check that the cabinet is de-energized.
- A cabinet key is available.

Procedure

1. Open the cabinet doors.
2. Check that the cabinet is de-energized.
3. Disassemble the fan plates and unplug the connector at the fans
4. Loosen the screws on the fan and replace the fans with new ones.
5. Mount the fan plates with the new fans in the control cabinet.
6. Close the cabinet doors.
7. Energize the feeders at the DC and AC inputs again.
8. Start up the control cabinet again. See Chapter Commissioning the inverter (Page 128).

11.5 Replacing the fan of the inverter module (ALM)

The typical service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables (e.g., ambient temperature, cabinet enclosure, etc.) and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the device is available.

Requirements

- The control cabinet has been properly shut down. See Chapter Decommissioning the entire inverter (Page 134).
- The feeders at the DC and AC inputs are de-energized.
- A voltage tester is available to check that the cabinet is de-energized.
- A cabinet key is available.

Procedure

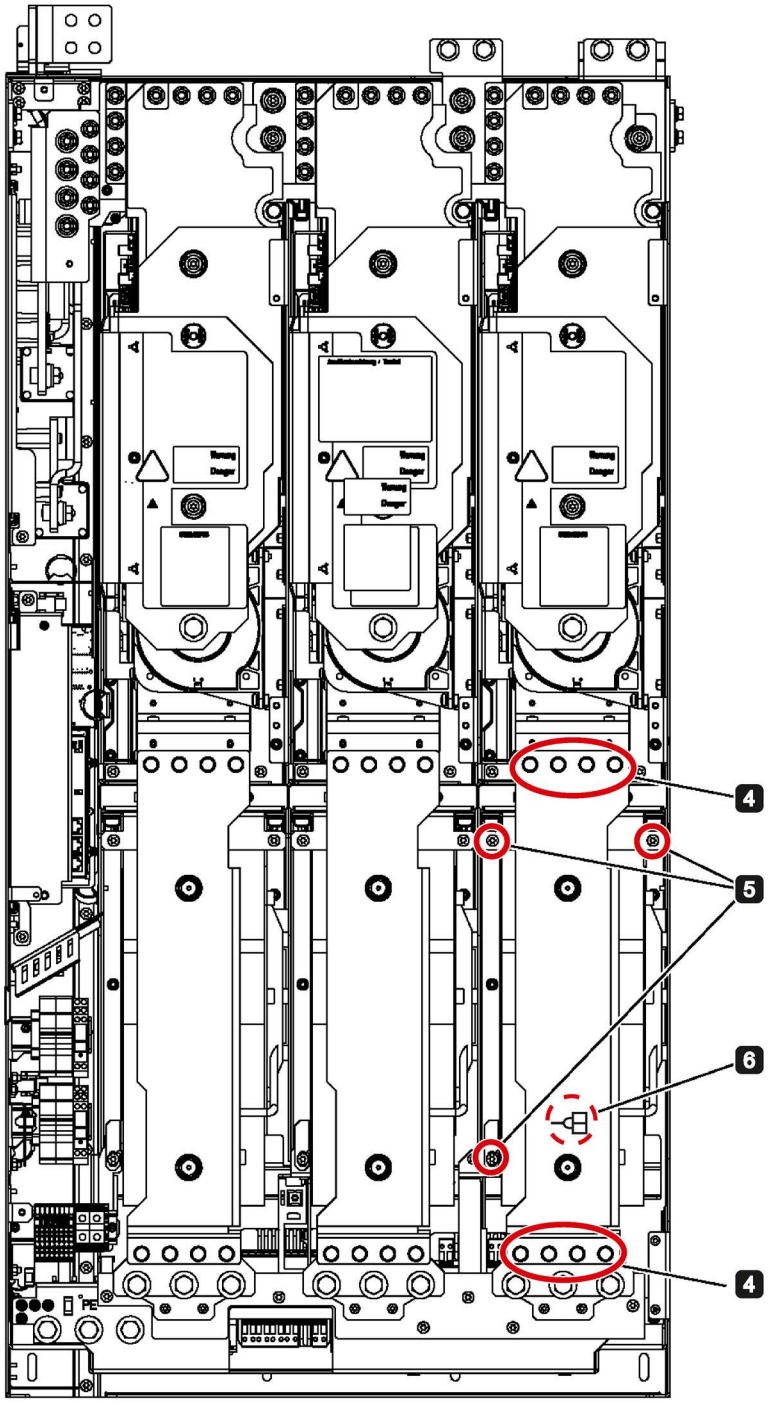


Figure 11-1 Replace the fans of the inverter module

Removal steps

1. Open the control cabinet doors.
2. Check safe isolation from power supply.
3. Remove the protective cover from the inverter module.
4. Unscrew 8 screws and remove the busbar
   – The removal steps are numbered in accordance with the figure.
5. Remove the retaining screws for the fan (3 screws)
6. Disconnect the supply cables to the fan (1 x "L", 1 x "N")
7. Removing the fan

NOTICE
When removing the fan, ensure that the cables are not damaged.

Installation steps

1. To install the fan, follow these steps in reverse order.

NOTICE
• The tightening torques specified in the table "Tightening torques for connecting current-conducting parts" must be observed. • Carefully establish the plug connections and ensure that they are secure. • The screw connections for the protective covers may only be tightened by hand.

2. Fitting the protective covers.
3. Close the control cabinet doors.

Recommissioning

1. Energize the feeders at the DC and AC inputs again.
2. Start up the control cabinet again. See Chapter Commissioning the inverter (Page 128).

Torques for screw connections on the inverter

Table 11- 2 Tightening torques for screw connection of current-conducting parts

Screw	Torque
M6	6 Nm
M8	13 Nm
M10	25 Nm
M12	50 Nm

Technical data

12

12.1 Environmental conditions

Storage and transport

Ambient temperature	-25 °C ... +70 °C
Relative humidity	0 % ... 95 %

Operation

Ambient temperature	0°C ... 50°C
Relative humidity/without condensation	0 % ... 95 %
Maximum installation altitude with derating	< 2000 m above sea level
Maximum installation altitude without derating	≤ 1000 m above sea level
Supply air temperature/ at rated value of the output AC active power/maximum	40 °C
Climate class	3K3

Cooling

Cooling method	Forced cooling by means of fans
Throughput of cooling air per inverter subunit	6500m^3/h
Air intake	Front of cabinet
Air discharge	Top of cabinet

12.2 Mechanical data

Date	Specification	Value
Mounting position	vertical	
Type of fixing	Floor mounting	
Dimensions without pallet (W x H x D)	Per control cabinet	1 350 x 2 100 x 730 mm
	Both control cabinets (mounted) together	2 700 x 2 100 x 730 mm
Weight	Overall system[1] PVS 600Series	2 085 kg
	Pallet/per cabinet	approx. 30 kg
Color	RAL 7035	

[1] The weight refers to the overall system without options

12.3 Electrical data

Input data (DC) PVS500

	PVS500	PVS1000	PVS1500	PVS2000
MPP voltage range	450 ... 750 V			
Maximum input voltage	820 V (1 000 V optional)			
Minimum input voltage	450 V			
Rated input voltage	465 VDC			
Rated input power	513 kW	1 026 kW	1 539 kW	2 052 kW
Maximum input current	1 103 A	2 206 A	3 309 A	4 412 A
Number of DC inputs	3	6	9	12
Maximum current per input	368 A			
Maximum current of the master/slave connection.	1 103 A			

Output data (AC) PVS500

	PVS500	PVS1000	PVS1500	PVS2000
Phases	3			
Rated voltage	288 V			
Grid voltage[1)]	244.8 ... 316.8			
Rated frequency	50 Hz / 60 Hz			
Grid frequency for infeed mode[1)]	47.5 ... 51.5 Hz 58.8 ... 61.2 Hz			
Rated power[2)]	500 kW	1 000 kW	1 500 kW	2 000 kW
Maximum apparent power	500 kVA	1 000 kVA	1 500 kVA	2 000 kVA
Maximum output current	1 002 A	2 004 A	3 006 A	4 008 A
Power factor	0.8 ... 1			
Inductive power factor	0.8			
Capacitive power factor	0.8			

1) The specified values describe the technical properties of the device. The locally required shutdown values may deviate from this.

2) Applies under the following conditions: Power factor = 1, ambient temperature ≤ 40°C, installation altitude ≤ 1 000 m, input voltage = 465 V

Efficiency/power losses PVS500

	PVS500	PVS1000	PVS1500	PVS2000
European efficiency[1)]	98.1 %	98.3 %	98.3 %	98.3 %
CEC efficiency[1)]	98.2 %	98.3 %	98.3 %	98.3 %
Maximum efficiency[1)]			98.4 %	
Power loss in night-time operation:				
• At 50 Hz, without cabinet heating	190 W	380 W	570 W	760 W
• At 50 Hz, with cabinet heating	440 W	880 W	1 320 W	1 760 W
• At 60 Hz, without cabinet heating	350 W	700 W	1 050 W	1 400 W
• At 60 Hz, with cabinet heating	600 W	1 200 W	1 800 W	2 400 W
Maximum power loss in operation:				
• At 50 Hz, without cabinet heating	2 650 W	5 300 W	7 950 W	10 600 W
• At 50 Hz, with cabinet heating	2 900 W	5 800 W	8 700 W	11 600 W
• At 60 Hz, without cabinet heating	3 500 W	7 000 W	10 500 W	14 000 W
• At 60 Hz, with cabinet heating	3 750 W	7 500 W	11 250 W	15 000 W

1) Specifications without auxiliary voltage supply

Input data (DC) PVS585

	PVS585	PVS1170	PVS1755	PVS2340
MPP voltage range	530 ... 750 V			
Maximum input voltage	820 V (1 000 V optional)			
Minimum input voltage	530 V			
Rated input voltage	540 VDC			
Rated input power	598 kW	1 196 kW	1 794 kW	2 392 kW
Maximum input current	1 104 A	2 208 A	3 312 A	4 416 A
Number of DC inputs	3	6	9	12
Maximum current per input	368 A			
Maximum current of the master/slave connection.	1 104 A			

Output data (AC) PVS585

	PVS585	PVS1170	PVS1755	PVS2340
Phases	3			
Rated voltage	340 V			
Grid voltage[1)]	289 ... 374			
Rated frequency	50 Hz / 60 Hz			
Grid frequency for infeed mode[1)]	47.5 ... 51.5 Hz 58.8 ... 61.2 Hz			
Rated power[2)]	585 kW	1 170 kW	1 755 kW	2 340 kW
Maximum apparent power	585 kVA	1 170 kVA	1 755 kVA	2 340 kVA
Maximum output current	995 A	1 990 A	2 985 A	3 980 A
Power factor	0.8 ... 1			
Inductive power factor	0.8			
Capacitive power factor	0.8			

1) The specified values describe the technical properties of the device. The locally required shutdown values may deviate from this.

2) Applies under the following conditions: Power factor = 1, ambient temperature ≤ 40°C, installation altitude ≤ 1000 m, input voltage = 540 V

Efficiency/power losses PVS585

	PVS585	PVS1170	PVS1755	PVS2340
European efficiency[1)]	98.2 %	98.4 %	98.4 %	98.4 %
CEC efficiency[1)]	98.3 %	98.3 %	98.4 %	98.4 %
Maximum efficiency[1)]			98.6 %	
Power loss in night-time operation:				
• At 50 Hz, without cabinet heating	190 W	380 W	570 W	760 W
• At 50 Hz, with cabinet heating	440 W	880 W	1 320 W	1 760 W
• At 60 Hz, without cabinet heating	350 W	700 W	1 050 W	1 400 W
• At 60 Hz, with cabinet heating	600 W	1 200 W	1 800 W	2 400 W
Maximum power loss in operation:				
• At 50 Hz, without cabinet heating	2 650 W	5 300 W	7 950 W	10 600 W
• At 50 Hz, with cabinet heating	2 900 W	5 800 W	8 700 W	11 600 W
• At 60 Hz, without cabinet heating	3 500 W	7 000 W	10 500 W	14 000 W
• At 60 Hz, with cabinet heating	3 750 W	7 500 W	11 250 W	15 000 W

1) Specifications without auxiliary voltage supply

Input data (DC) PVS600

	PVS600	PVS1200	PVS1800	PVS2400
MPP voltage range	570 ... 750 V			
Maximum input voltage	820 V (1 000 V optional)			
Minimum input voltage	570 V			
Rated input voltage	570 VDC			
Rated input power	613 kW	1 226 kW	1 839 kW	2 452 kW
Maximum input current	1104	2 208 A	3 312 A	4 416 A
Number of DC inputs	3	6	9	12
Maximum current per input	368 A			
Maximum current of the master/slave connection.	1 104 A			

Output data (AC) PVS600

	PVS600	PVS1200	PVS1800	PVS2400
Phases	3			
Rated voltage	370 V			
Grid voltage[1)]	314.5 ... 407			
Rated frequency	50 Hz / 60 Hz			
Grid frequency for infeed mode[1)]	47.5 ... 51.5 Hz 58.8 ... 61.2 Hz			
Rated power[2)]	600 kW	1 200 kW	1 800 kW	2 400 kW
Maximum apparent power	600 kVA	1 200 kVA	1 800 kVA	2 400 kVA
Maximum output current	936 A	1 872 A	2 808 A	3 744 A
Power factor	0.8 ... 1			
Inductive power factor	0.8			
Capacitive power factor	0.8			

1) The specified values describe the technical properties of the device. The locally required shutdown values may deviate from this.

2) Applies under the following conditions: Power factor = 1, ambient temperature ≤ 40°C, installation altitude ≤ 1 000 m, input voltage = 570 V

Efficiency/power losses PVS600

	PVS600	PVS1200	PVS1800	PVS2400
European efficiency[1)]	98.4 %	98.6 %	98.6 %	98.6 %
CEC efficiency[1)]	98.5 %	98.6 %	98.6 %	98.6 %
Maximum efficiency[1)]			98.7 %	
Power loss in night-time operation:				
• At 50 Hz, without cabinet heating	190 W	380 W	570 W	760 W
• At 50 Hz, with cabinet heating	440 W	880 W	1 320 W	1 760 W
• At 60 Hz, without cabinet heating	350 W	700 W	1 050 W	1 400 W
• At 60 Hz, with cabinet heating	600 W	1 200 W	1 800 W	2 400 W
Maximum power loss in operation:				
• At 50 Hz, without cabinet heating	2 650 W	5 300 W	7 950 W	10 600 W
• At 50 Hz, with cabinet heating	2 900 W	5 800 W	8 700 W	11 600 W
• At 60 Hz, without cabinet heating	3 500 W	7 000 W	10 500 W	14 000 W
• At 60 Hz, with cabinet heating	3 750 W	7 500 W	11 250 W	15 000 W

1) Specifications without auxiliary voltage supply

Input data (DC) PVS630

	PVS630	PVS1260	PVS1890	PVS2520
MPP voltage range	570 ... 750 V			
Maximum input voltage	820 V (1 000 V optional)			
Minimum input voltage	570 V			
Rated input voltage	600 VDC			
Rated input power	643 kW	1 286 kW	1 929 kW	2 572 kW
Maximum input current	1 104 A	2 208 A	3 312 A	4 416 A
Number of DC inputs	3	6	9	12
Maximum current per input	368 A			
Maximum current of the master/slave connection.	1 104 A			

Output data (AC) PVS630

	PVS630	PVS1260	PVS1890	PVS2520
Phases	3			
Rated voltage	370 V			
Grid voltage[1)]	314.5 ... 407			
Rated frequency	50 Hz / 60 Hz			
Grid frequency for infeed mode[1)]	47.5 ... 51.5 Hz 58.8 ... 61.2 Hz			
Rated power[2)]	630 kW	1 260 kW	1 890 kW	2 520 kW
Maximum apparent power	630 kVA	1 260 kVA	1 890 kVA	2 520 kVA
Maximum output current	985 A	1 970 A	2 955 A	3 950 A
Power factor	0.8 ... 1			
Inductive power factor	0.8			
Capacitive power factor	0.8			

1) The specified values describe the technical properties of the device. The locally required shutdown values may deviate from this.

2) Applies under the following conditions: Power factor = 1, ambient temperature ≤ 40°C, installation altitude ≤ 1000 m, input voltage = 585 V

Efficiency/power losses PVS630

	PVS630	PVS1260	PVS1890	PVS2520
European efficiency[1)]	98.3 %	98.5 %	98.5 %	98.5 %
CEC efficiency[1)]	98.4 %	98.5 %	98.5 %	98.5 %
Maximum efficiency[1)]			98.7 %	
Power loss in night-time operation:				
• At 50 Hz, without cabinet heating	190 W	380 W	570 W	760 W
• At 50 Hz, with cabinet heating	440 W	880 W	1 320 W	1 760 W
• At 60 Hz, without cabinet heating	350 W	700 W	1 050 W	1 400 W
• At 60 Hz, with cabinet heating	600 W	1 200 W	1 800 W	2 400 W
Maximum power loss in operation:				
• At 50 Hz, without cabinet heating	2 650 W	5 300 W	7 950 W	10 600 W
• At 50 Hz, with cabinet heating	2 900 W	5 800 W	8 700 W	11 600 W
• At 60 Hz, without cabinet heating	3 500 W	7 000 W	10 500 W	14 000 W
• At 60 Hz, with cabinet heating	3 750 W	7 500 W	11 250 W	15 000 W

1) Specifications without auxiliary voltage supply

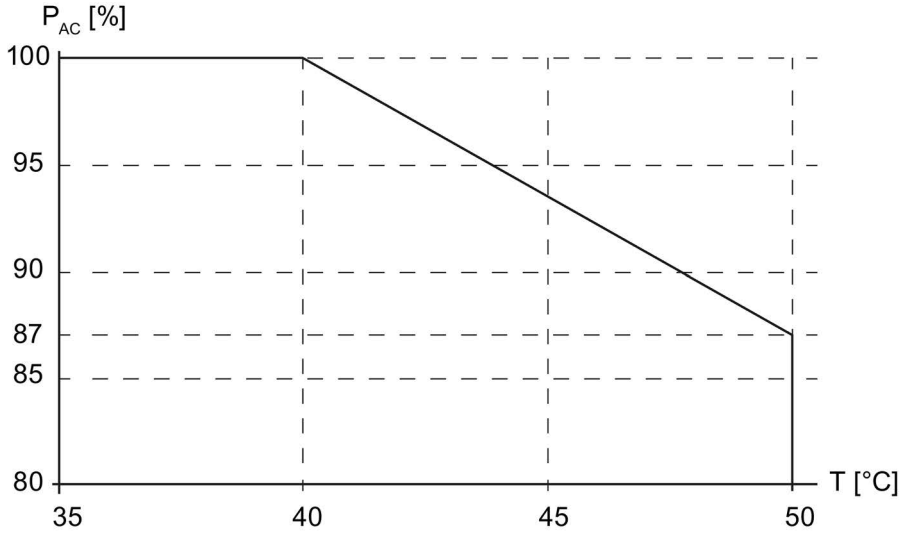
General electrical data

Power components	IGBT
Galvanic isolation AC side	AC output direct at medium voltage transformer Each subunit of an inverter must be connected to the medium-voltage transformer with galvanic isolation.
Auxiliary power supply per inverter	400 V ± 10%, 50 Hz / 60 Hz; (47 ... 63 Hz) fused with 16 A per phase

Derating

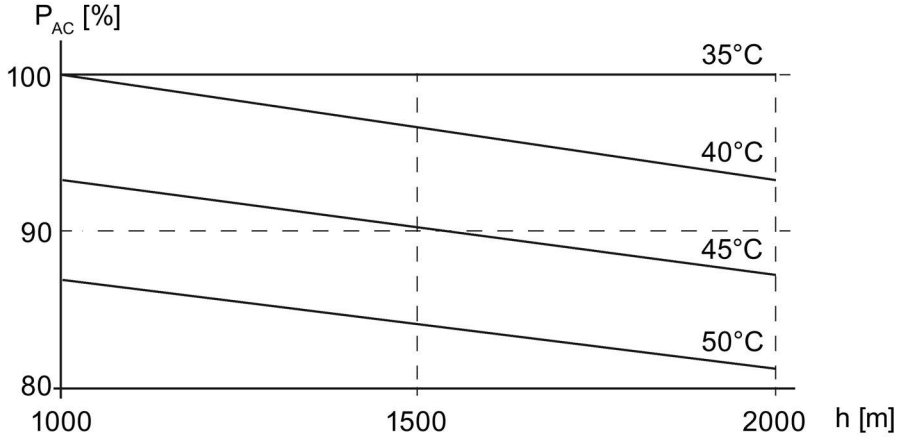
At ambient temperatures (= supply air temperature) T > 40°C the maximum permissible output power P_{AC} [%] reduces at cosφ = 1 and an installation altitude of ≤ 1 000 m as follows:

Derating depending on the ambient temperature (= supply air temperature) T [°C] at h ≤ 1 000 m



At higher installation altitudes h [m] above sea level, note the maximum permissible output power P_{AC} [%] at cosφ = 1:

Derating depending on the ambient temperature (= supply air temperature) T [°C] and altitude h [m] above sea level



Connections

Electrical connection version at the DC input	Ring terminal lug
Connection screw version at the DC input	M12
Tightening torque at the DC input	70 Nm
Electrical connection version at the AC input	Ring terminal lug
Connection screw version at the AC input	M12
Tightening torque at the AC input	70 Nm
Electrical connection version for auxiliary voltage	Screw-type connection
Connecting screw version for auxiliary voltage	M3
Tightening torque for auxiliary voltage	0.6 … 0.8 Nm
Connectable conductor cross-section for auxiliary voltage	2.5 ... 4 mm^2

12.4 Operator panel and interfaces

Display	Type	LCD TFT
	Resolution	480 x 272 pixels
	Colors	256
	Input unit	Touch screen
Data interface		Ethernet

12.5 Applicable standards and conformity

Conformity	CE
Electrical safety	EN 50178
EMC immunity	EN 61000-6-2
EMC interference emission	EN 61000-6-4*
IP degree of protection	IP20 according to EN 60529
Equipment protection class	I

* In master/slave mode, a minimum distance of 20 m must be maintained to the boundary between the installation and the public domain for compliance with EMC Directive 2004 / 108 / EC. Alternatively, the system can be set up in metal containers with a damping effect of at least 10 dB.

Dimension drawings

13

13.1 Control cabinet

Master

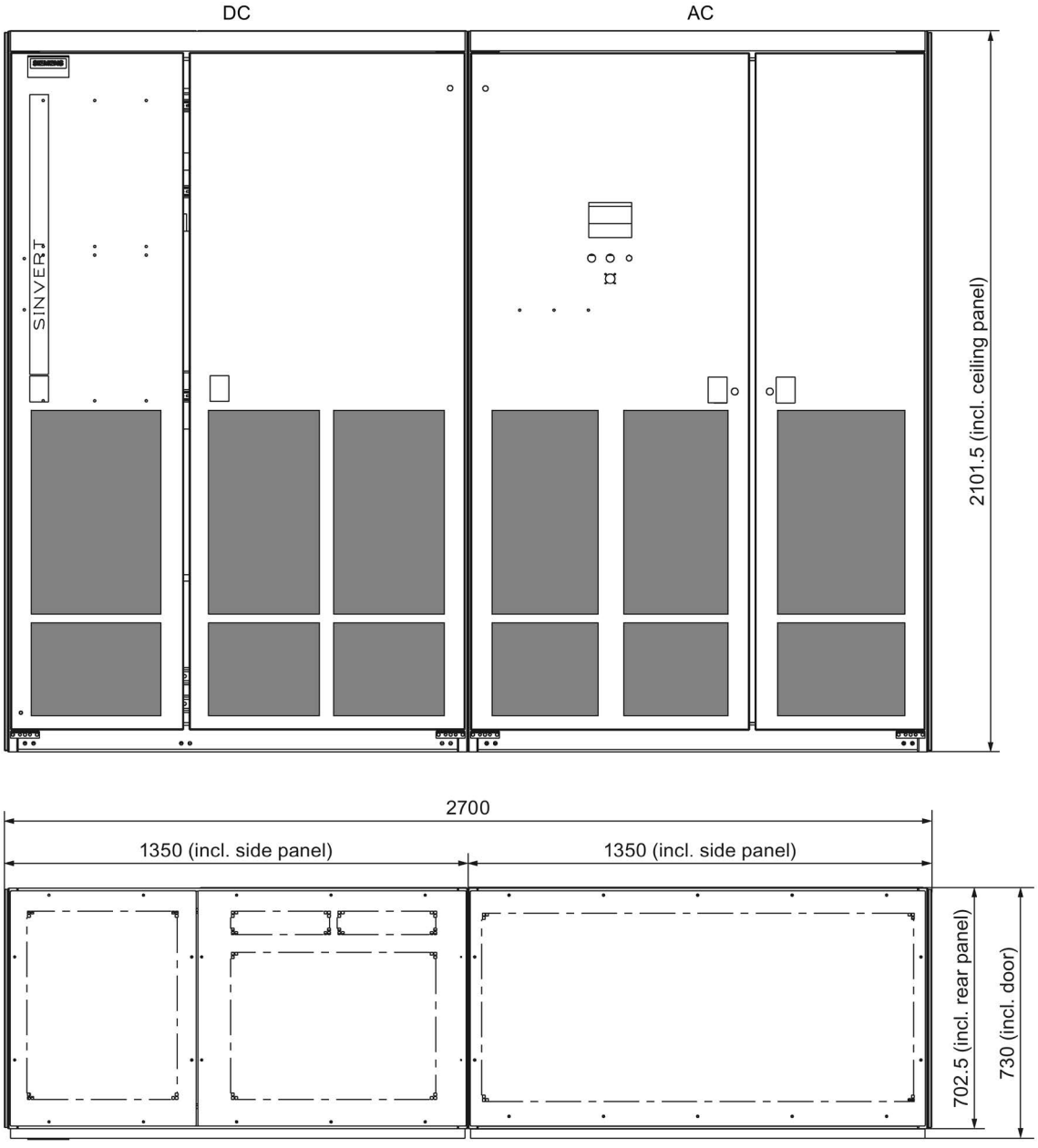


Figure 13-1 Dimension drawing master

Slave

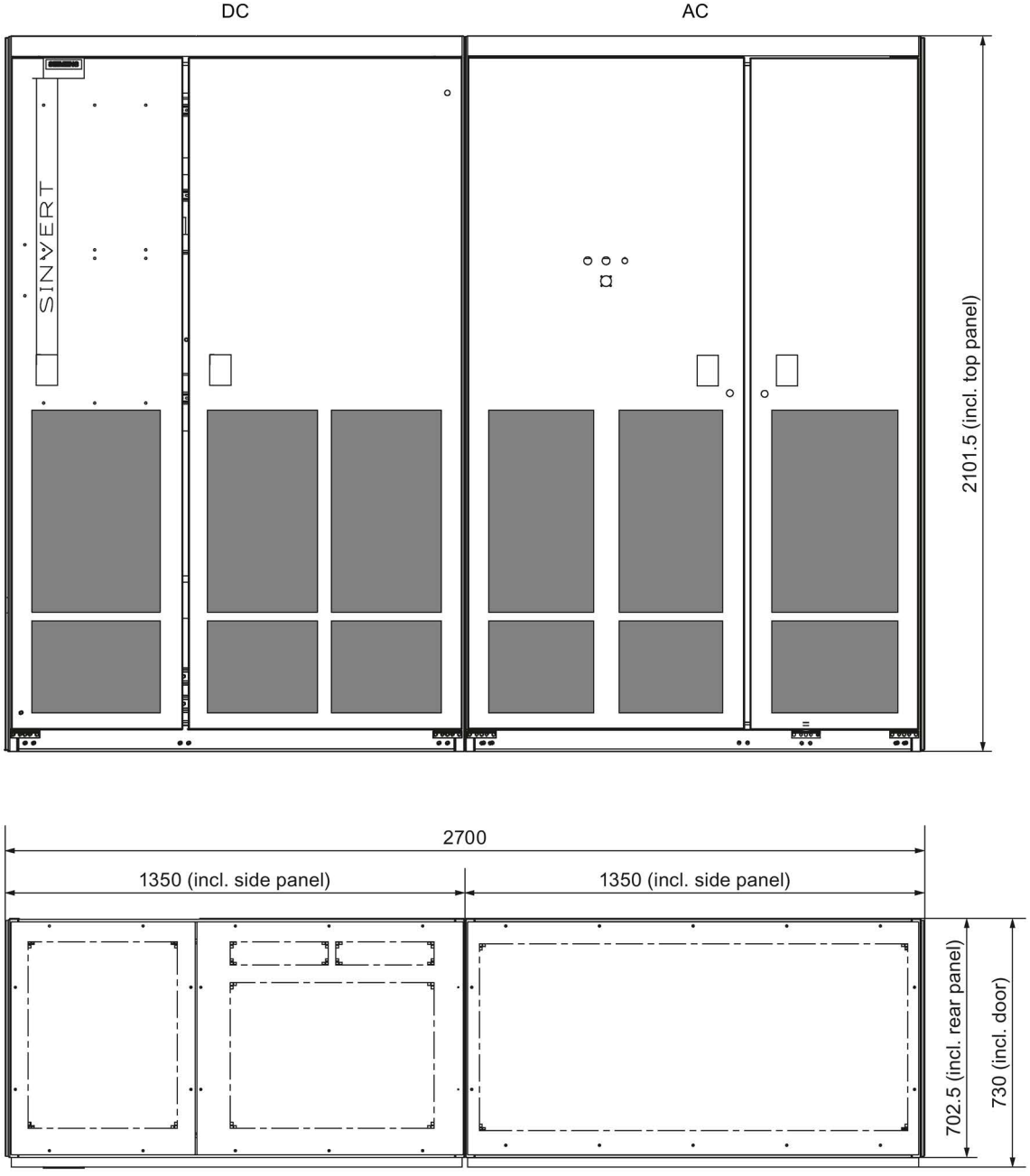


Figure 13-2 Dimension drawing slave

13.2 Base plate

Master

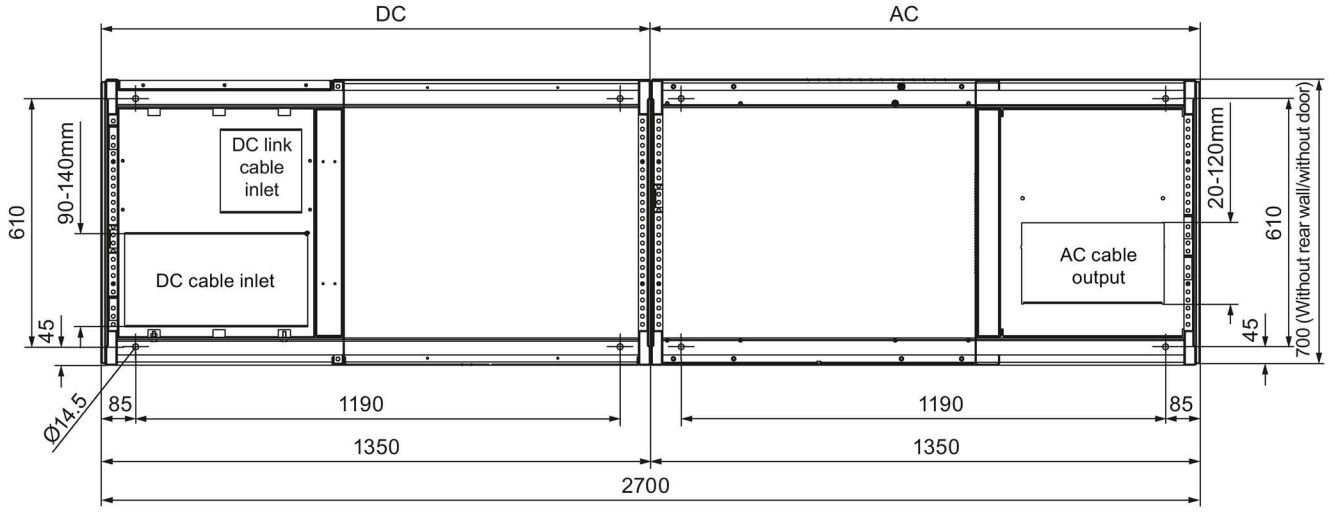


Figure 13-3 Dimension drawing base plate master

Slave

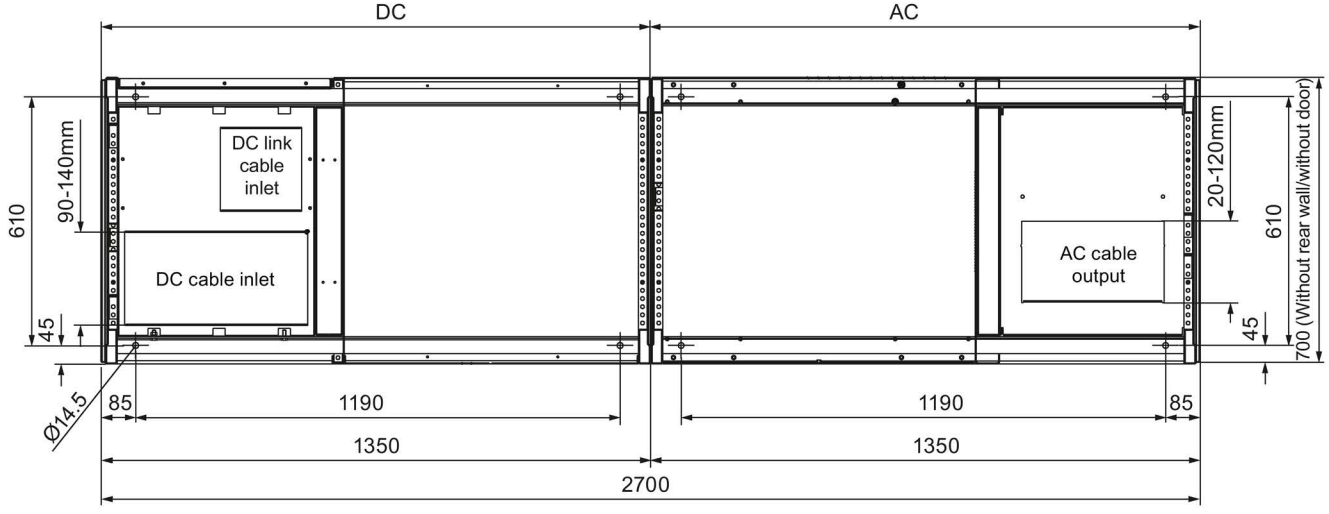


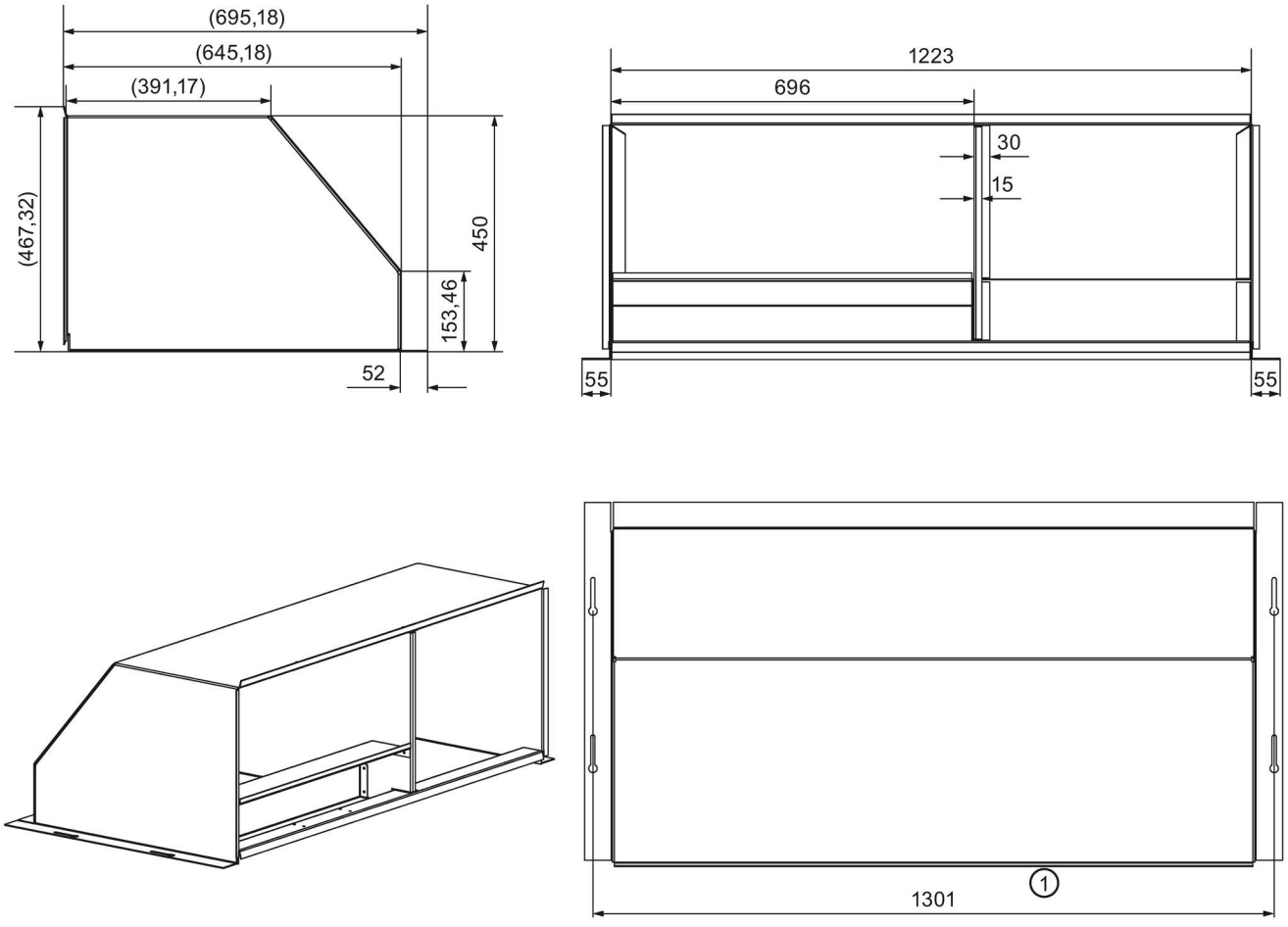
Figure 13-4 Dimension drawing base plate slave

13.3 Exhaust-air shrouds (optional)

The exhaust-air shrouds are available as accessories. For details, see Section Accessories (Page 208).

The exhaust-air shrouds for the DC cabinet and the AC cabinet of the inverter differ only in their air deflectors. The basic shroud, partition, and cross struts are identical on both exhaust-air shrouds.

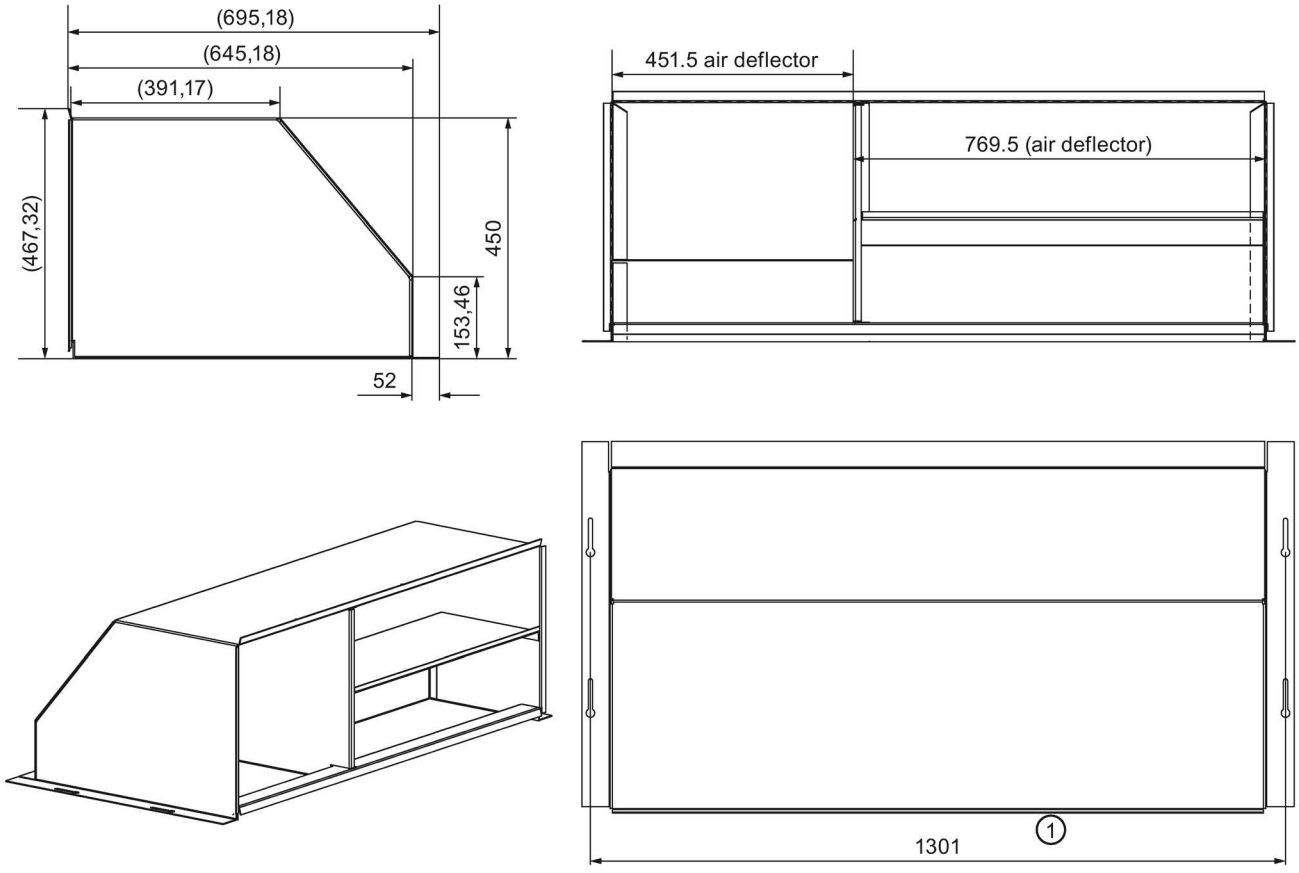
Dimension drawing exhaust-air shroud DC



① Gap between the screw points

Figure 13-5 Dimension drawing exhaust-air shroud DC

Dimension drawing exhaust-air shroud AC



① Gap between the screw points

Figure 13-6 Dimension drawing exhaust-air shroud AC

Ordering data

14

14.1 SINVERT PVS inverters

Inverters

Type series	Designation	Order number (MLFB)
SINVERT PVS500 for 50 Hz networks	SINVERT PVS500	6AG3111-1AH00-3AB0[1)]
	SINVERT PVS1000	6AG3111-1AH10-3AB0[1)]
	SINVERT PVS1500	6AG3111-1AH20-3AB0[1)]
	SINVERT PVS2000	6AG3111-1AH30-3AB0[1)]
SINVERT PVS500 for 60 Hz networks	SINVERT PVS500	6AG3111-2AH00-3AB0[1)]
	SINVERT PVS1000	6AG3111-2AH10-3AB0[1)]
	SINVERT PVS1500	6AG3111-2AH20-3AB0[1)]
	SINVERT PVS2000	6AG3111-2AH30-3AB0[1)]
SINVERT PVS585 for 50 Hz networks	SINVERT PVS585	6AG3111-1AH00-7AB0[1)]
	SINVERT PVS1170	6AG3111-1AH10-7AB0[1)]
	SINVERT PVS1755	6AG3111-1AH20-7AB0[1)]
	SINVERT PVS2340	6AG3111-1AH30-7AB0[1)]
SINVERT PVS585 for 60 Hz networks	SINVERT PVS585	6AG3111-2AH00-7AB0[1)]
	SINVERT PVS1170	6AG3111-2AH10-7AB0[1)]
	SINVERT PVS1755	6AG3111-2AH20-7AB0[1)]
	SINVERT PVS2340	6AG3111-2AH30-7AB0[1)]
SINVERT PVS600 for 50 Hz networks	SINVERT PVS600	6AG3111-1AH00-0AB0[1)]
	SINVERT PVS1200	6AG3111-1AH10-0AB0[1)]
	SINVERT PVS1800	6AG3111-1AH20-0AB0[1)]
	SINVERT PVS2400	6AG3111-1AH30-0AB0[1)]
SINVERT PVS600 for 60 Hz networks	SINVERT PVS600	6AG3111-2AH00-0AB0[1)]
	SINVERT PVS1200	6AG3111-2AH10-0AB0[1)]
	SINVERT PVS1800	6AG3111-2AH20-0AB0[1)]
	SINVERT PVS2400	6AG3111-2AH30-0AB0[1)]

Type series	Designation	Order number (MLFB)
SINVERT PVS630 for 50 Hz networks	SINVERT PVS630	6AG3111-1AH00-8AB0[1)]
	SINVERT PVS1260	6AG3111-1AH10-8AB0[1)]
	SINVERT PVS1890	6AG3111-1AH20-8AB0[1)]
	SINVERT PVS2520	6AG3111-1AH30-8AB0[1)]
SINVERT PVS630 for 60 Hz networks	SINVERT PVS630	6AG3111-2AH00-8AB0[1)]
	SINVERT PVS1260	6AG3111-2AH10-8AB0[1)]
	SINVERT PVS1890	6AG3111-2AH20-8AB0[1)]
	SINVERT PVS2520	6AG3111-2AH30-8AB0[1)]

[1)] Order number of the basic unit without additional inverter options.

The available inverter options are described in the following chapter: Inverter options (Page 28)

Order information

The SINVERT PVS inverter can be ordered with additional options. To do so, the order number of the basic unit must be followed by the order number of the option in the same order. The options are supplied already built into the basic unit and can only be ordered in conjunction with the basic unit. Options cannot be ordered later.

14.2 Options

Inverter options

Option 600 series	For inverters	Order number (MLFB)
1000 V option	PVS500/585/600/630	6AG3911-3GA00-0AH0
	PVS1000/1170/1200/1260	6AG3911-3GA10-0AH0
	PVS1500/1755/1800/1890	6AG3911-3GA20-0AH0
	PVS2000/2340/2400/2520	6AG3911-3GA30-0AH0
PV array grounding positive pole	PVS500/585/600/630	6AG3911-3FA00-0AH0
	PVS1000/1170/1200/1260	6AG3911-3FA10-0AH0
	PVS1500/1755/1800/1890	6AG3911-3FA20-0AH0
	PVS2000/2340/2400/2520	6AG3911-3FA30-0AH0
PV array grounding negative pole	PVS500/585/600/630	6AG3911-3FB00-0AH0
	PVS1000/1170/1200/1260	6AG3911-3FB10-0AH0
	PVS1500/1755/1800/1890	6AG3911-3FB20-0AH0
	PVS2000/2340/2400/2520	6AG3911-3FB30-0AH0
Cabinet heating	PVS500/585/600/630	6AG3911-3HA00-1AH0
	PVS1000/1170/1200/1260	6AG3911-3HA10-1AH0
	PVS1500/1755/1800/1890	6AG3911-3HA20-1AH0
	PVS2000/2340/2400/2520	6AG3911-3HA30-1AH0
Symmetry monitoring	PVS500/585/600/630	6AG3911-3EA00-0AH0
	PVS1000/1170/1200/1260	6AG3911-3EA10-0AH0
	PVS1500/1755/1800/1890	6AG3911-3EA20-0AH0
	PVS2000/2340/2400/2520	6AG3911-3EA30-0AH0

Order information

The SINVERT PVS inverter can be ordered with additional options. To do so, the order number of the basic unit must be followed by the order number of the option in the same order. The options are supplied already built into the basic unit and can only be ordered in conjunction with the basic unit. Options cannot be ordered later.

Example of an order with two options:

Scope of order: PVS1000 basic unit with 50 Hz including 1000 V option and PV array grounding positive pole:

1. item: 6AG3111-1AH10-3AB0 (PVS1000 basic unit 600 series IEC 50 Hz M1S)
2. item: 6AG3911-3GA10-0AH0 (1000 V option 600 series M1S)
3. item: 6AG3911-3FA10-0AH0 (PV array grounding positive pole M1S)

14.3 Accessories

Exhaust-air shroud

You can find information about the available accessories in the current catalog, obtainable from your sales partner.

Quantity	Description	Available from
1	Exhaust-air shrouds for DC and AC cabinet, including • 8 x M5x16 screws • 8 x contact washers 5 mm • Foam rubber 736 mm	Siemens AG (Order number: 6AG3911-3CA20-1AY0)

LV HRC fuse puller

Quantity	Description	Available from
1	LV HRC fuse puller for LV HRC fuses or disconnecting blade with puller lug gap 120 mm, 1500 V, size 3L	e.g. Efen (Order no.: 36018.0010)

Technical support

A

Technical support for SINVERT products

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  - Brochures
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  SINVERT support (http://www.siemens.com/sinvert-support)
  Here you can find, for example:
  - Manuals and operating instructions
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For all technical queries, please contact:

- Phone: +49 (911) 895-5900
  Monday to Friday, 8 am – 5 pm CET
- Fax: +49 (911) 895-5907
- E-mail: Technical assistance (mailto:technical-assistance@siemens.com)

Overview of master slave cabling

B

Overview of master slave cabling

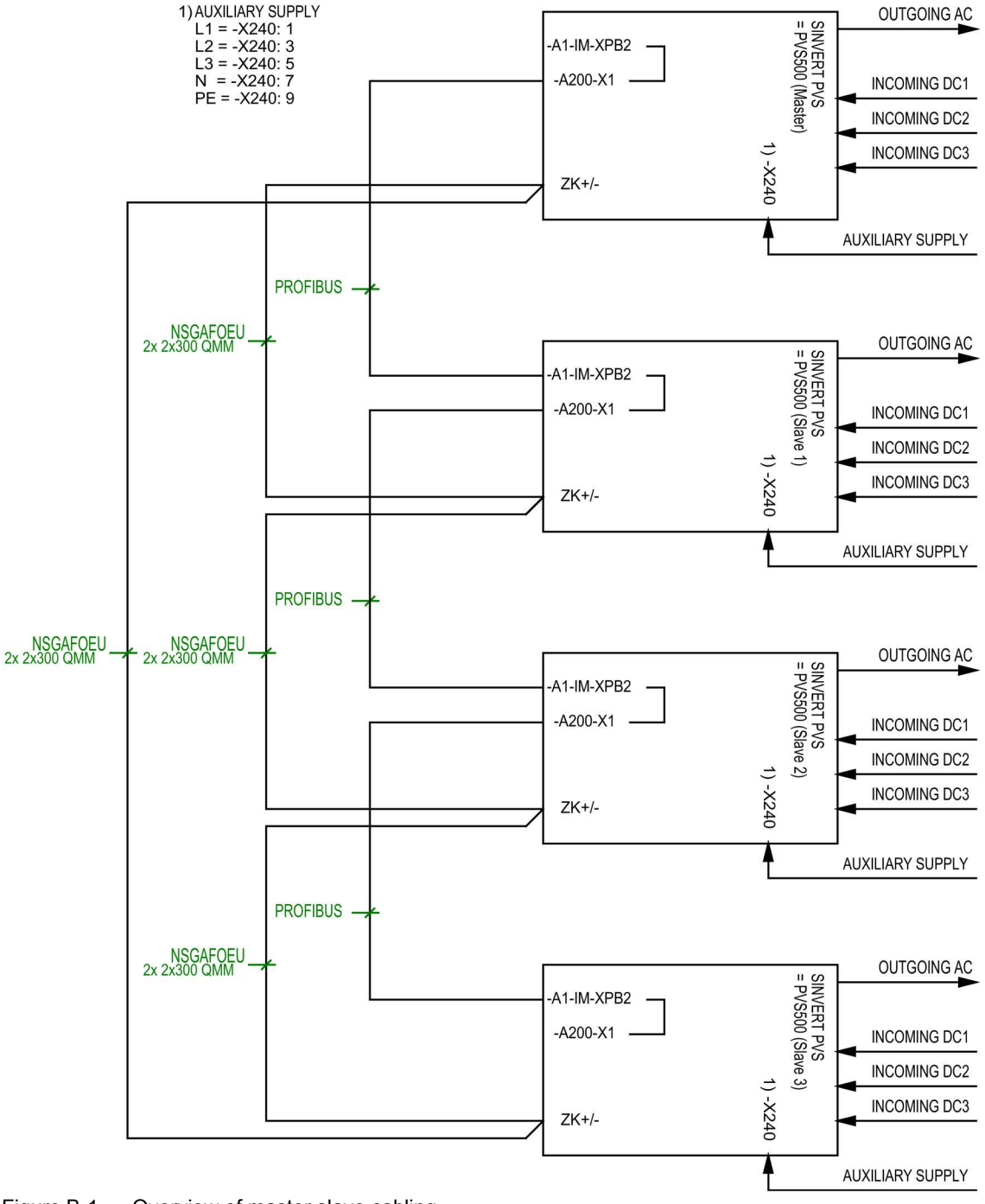

Figure B-1 Overview of master slave cabling

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